HP A8800 Routers

Installation Guide

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Preparing for installation

Overview

This series is a line of data center routers. You can deploy the A8800 routers at the core layer and distribution layer of large-scale MANs, the core layer of enterprise networks, and the distribution layer of carrier networks. Table 1 lists the chassis models in the series.

Table 1 Router chassis

Chassis	Power input	Card slot orientation	MPU slots	LPU slots
A8805	AC/DC	Horizontal	2	5
A8808	AC/DC	Vertical	2	8
A8812	AC/DC	Horizontal	2	12

NOTE:

- An MPU is the supervisor engine of a router. An LPU receives and forwards traffic and provides network services.
- The LPU slots can hold SPE cards, SPC cards, and OAA modules. For card specifications, see "Hardware specifications."

Safety recommendations

⚠ WARNING!

Before installation and operation, read all of the safety instructions in the *Compliance and Safety Guide* supplied with your device.

This section provides general recommendations. For more information, see the *Compliance and Safety Guide*.

- Turn off all power and remove all power cables before opening the chassis.
- Unplug all power and external cables before moving the chassis.
- Locate the emergency power-off switch before installation and shut off power immediately if necessary.
- Always wear an ESD-preventive wrist strap when installing the router.
- Do not stare into the open optical interface. The laser light emitted from the optical fiber may hurt your eyes
- Use a good grounding system to protect your router against lightning shocks, interference, and ESD. This is essential to the operating reliability of your router.
- Make sure the resistance between the chassis and the ground is less than 1 ohm.

Installation site requirements

The following tables provide information about temperature and humidity, cleanness, and air quality requirements.

CAUTION:

If condensation appears on the router when you move it to a high-temperature environment, dry the router before powering it on to avoid short circuits.

To ensure normal operation of the router, make sure the room temperature meets the requirements described in Table 2.

Table 2 Temperature requirements

Temperature	Range
Operating temperature	Long term: 0°C to 45°C (32°F to 113°F) Short term: –10°C to +55°C (14°F to 131°F) (no more than 96 hours of continuous operation in less than 15 days in one year)
Storage temperature	–40°C to +70°C (–40°F to +158°F)

Maintain appropriate humidity in your equipment room, as described in Table 3.

Table 3 Humidity requirements

Humidity	Range
Operating humidity (noncondensing)	5% to 95%
Storage humidity (noncondensing)	5% to 95%

Lasting high relative humidity tends to cause poor insulation, increased electricity consumption, mechanical property change of materials, and corrosion of metal parts. Lasting low relative humidity is likely to result in loose screws due to washer contraction, and even ESD, which causes the circuits to fail.

Table 4 Dust concentration limit in the equipment room

Physical active substance	Concentration limit (particles/m^3)
Dust particle	≤3 x 10^4 (No visible dust on desk over three days)
Note: Dust particle diameter ≥ 5μm	

Table 5 Limits on harmful gases in the equipment room

Gas	Max concentration (mg/m^3)
SO_2	0.2
H_2S	0.06
NH_3	0.05
Cl_2	0.01

Rack-mounting requirements

Before rack-mounting a router, make sure the rack meets the following requirements:

- HP recommends that the router is mounted in an open rack. If you mount a router in a closed rack, make sure there is a good heat dissipation system.
- The rack is steady enough to support the router and accessories.
- The router fits the rack size. Leave some space beside the left and right panels of the router for chassis heat dissipation.

Installation tools

Accessories supplied by the router

Item	Quantity	Purpose
Console cable	1	Connecting the console port and the configuration terminal for router login
Grounding cable	1	Grounding the router
Mounting brackets	1 pair	Fastening the router to the rack
Cable management brackets	1 pair	Cable management
M4*8 screw	1 set	• Fastening the mounting brackets to the router • Fastening the cable management brackets to the router
M6*12 screw	1 set	Fastening the router to the rack
M6 cage nut	1 set	
ST2.9*9.5 self-tapping screw	1 set	Fastening the cable management brackets to the mounting brackets (excluding the A8808)
Impedance carrier	1 (supplied with the A8808 only)	Installed at the rear of the router to block air from entering the chassis
ESD-preventive wrist strap	1	ESD prevention

NOTE:

The number of screws and nuts supplied with the router may vary.

User-supplied tools and equipment

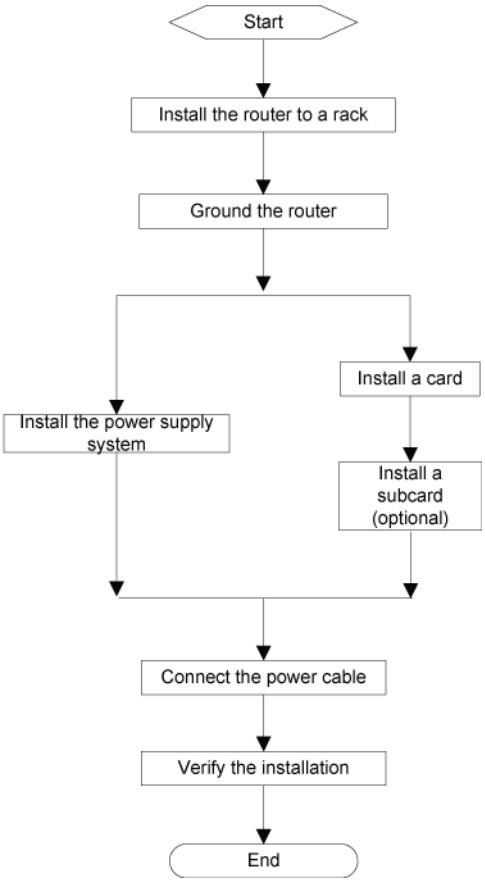
- Cross-head screwdriver P1 – 100 mm, P2 – 150 mm, and P3 – 250 mm
- Flat-blade screwdriver P4 – 75 mm
- Diagonal pliers, wire-stripping pliers, and wire clippers
- Meters and equipment such as hub and multimeter

The rack accessories and installation tools are not described in this section. The accessories and installation tools may vary depending on the rack model. For more information, see the installation guide for the corresponding rack.

Installing the router

Figure 1 shows the steps for installing the router.

Figure 1 Installation flowchart



Installation prerequisites

Before installing the router:

- Read "Preparing for installation" carefully and make sure the installation site meets all of the requirements.
- Using the packing list supplied with your router, inspect the router to make sure you have all of the items listed and verify that the router was not damaged during shipment. If anything is damaged or missing, contact HP immediately.

Installing the router in a rack

Confirm the following before starting installation:

- The rack is sturdy and securely grounded.
- There is at least 0.8 m (2.62 ft) of clearance around the rack for heat dissipation and installation.

- There is no debris inside or around the rack.
- The router can be installed only in a 4-post 19-inch standard rack.

Mounting slide rails to the rack

If the rack already has slide rails, skip this section. Slide rails or rack shelves are not provided with the router. Prepare them yourself or order them from HP. Make sure the slide rails or rack shelves you use are standard accessories.

In addition to slide rails, you can use a rack shelf to support the router. This document describes how to install slide rails only.

The following procedure uses a 19-inch rack as an example.

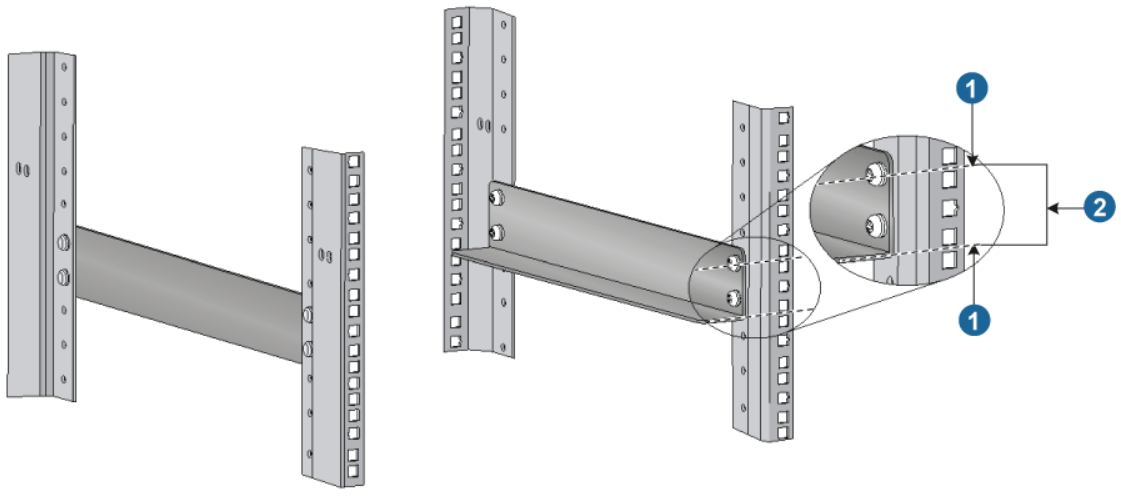
Before installing the slide rails, verify that the slide rails can support the weight of the router. For the weights of the router, see "Hardware specifications."

To install the slide rails:

1. Mark the positions of the slide rails on the rack. Make sure the space above the slide rails is greater than the height of the router chassis. For the router dimensions, see "Hardware specifications."
2. Install the slide rails to the lowest possible position when installing a single router on the rack. Make sure the bottom edge of the slide rail aligns with the middle of the narrower metal area between holes.
3. Align the screw holes on the two sides of the slide rails with the corresponding holes on the rack, and then fasten the screws.
4. Install the other slide rail in the same way. Keep the two slide rails at the same height so that the router can be placed evenly.

The height of the front panel of the rack is a measurement of one RU (44.45 mm, or 1.75 in). As shown in Figure 2, each 1 RU has three holes with center-to-center spacing between the holes of 15.87 mm (0.63 in), 15.87 mm (0.63 in), and 12.70 mm (0.5 in).

Figure 2 Installing the slide rails



(1) Middle of the narrower metal area between holes (2) 1 RU

NOTE:

The appearance and installation methods of slide rails depend on the slide rail types.

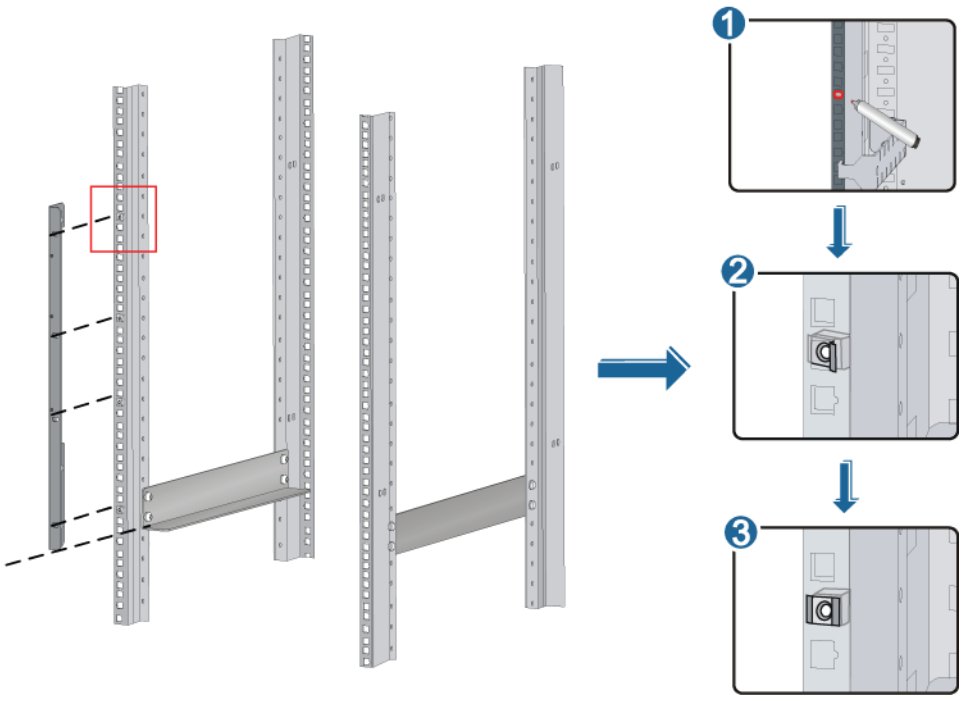
Installing cage nuts to the rack

Before mounting the chassis to the rack, install cage nuts to the front square-holed brackets of the rack, as shown in Figure 3.

When preparing for installation, make sure the total height of the routers to be installed does not exceed the height of the rack, and reserve enough clearance for cable routing.

1. Align the mounting bracket with the left rack post, making sure the bottom edge and the slide rail are level.
2. Mark the positions of the cage nuts on the rack post according to the installation holes on the mounting bracket.
3. Install the cage nuts to the right positions. (Each installation hole on the mounting bracket corresponds to one cage nut.)
4. Repeat steps 1 through 3 to install cage nuts to the correct rack post.

Figure 3 Installing the cage nuts



Installing the cable management brackets

This section includes separate steps for installing the cable management brackets on the A8808 and A8805/A8812.

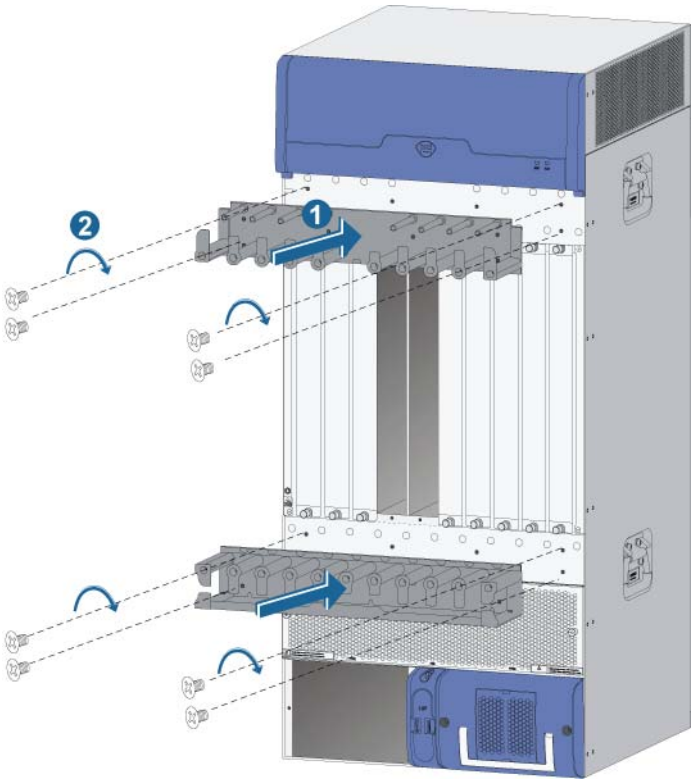
Installing the cable management brackets on the A8808

The A8808 has two cable management brackets and are installed using the same procedure. The signal cable management brackets are installed at the upper part of the router, and the power cable management brackets are installed at the lower part of the router.

To install a cable management bracket:

1. Attach the cable management bracket to the chassis, and align the screw holes on the cable management bracket with the screw holes on the chassis, as shown in Figure 4.
2. Screw in and fasten the M4 screws with a screwdriver.

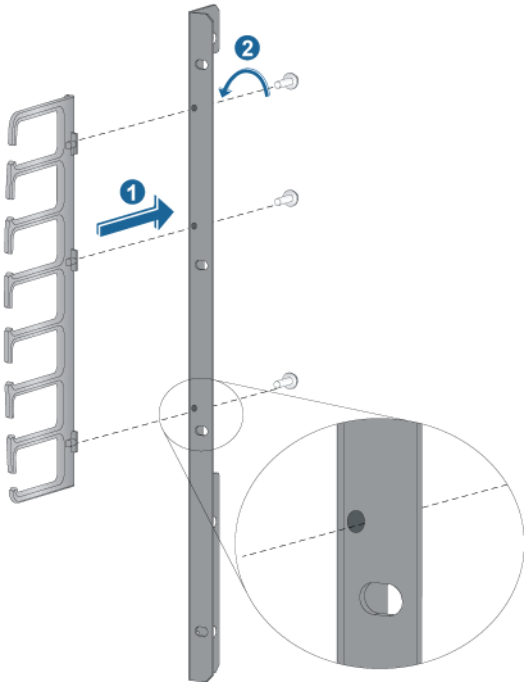
Figure 4 Installing the cable management brackets on the A8808



Installing the cable management brackets on the A8805/A8812

Install the cable management brackets to the mounting brackets (cable management brackets and mounting brackets are required at both sides of the chassis). Figure 5 shows how to install a right cable management bracket. The method for installing the left cable management bracket is the same as the right.

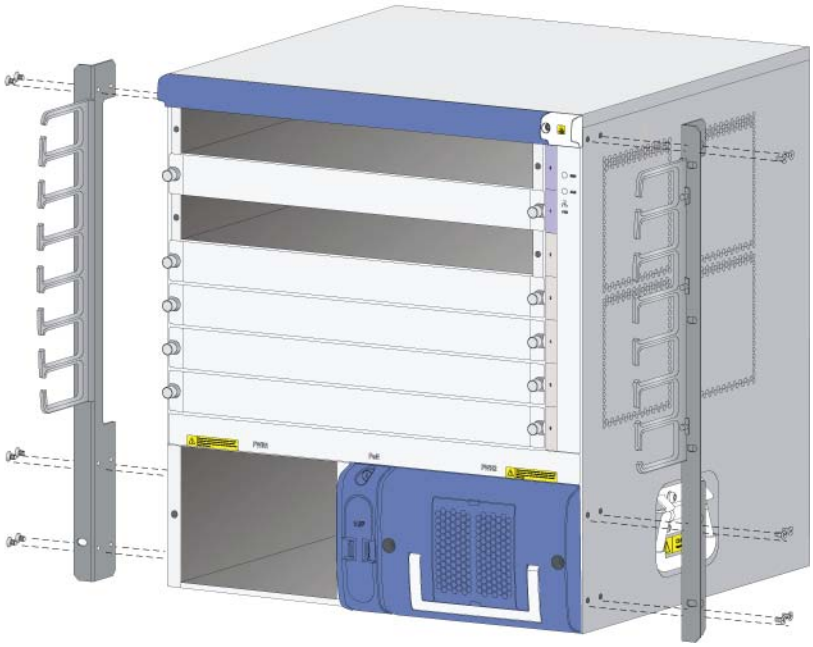
Figure 5 Installing the cable management bracket on the A8805/A8812



Installing the mounting brackets

Before installing the router to the rack, install the mounting brackets to the chassis. Figure 6 shows how to install the mounting brackets to an A8805 router.

Figure 6 Installing the mounting brackets



Installing an impedance carrier (optional)

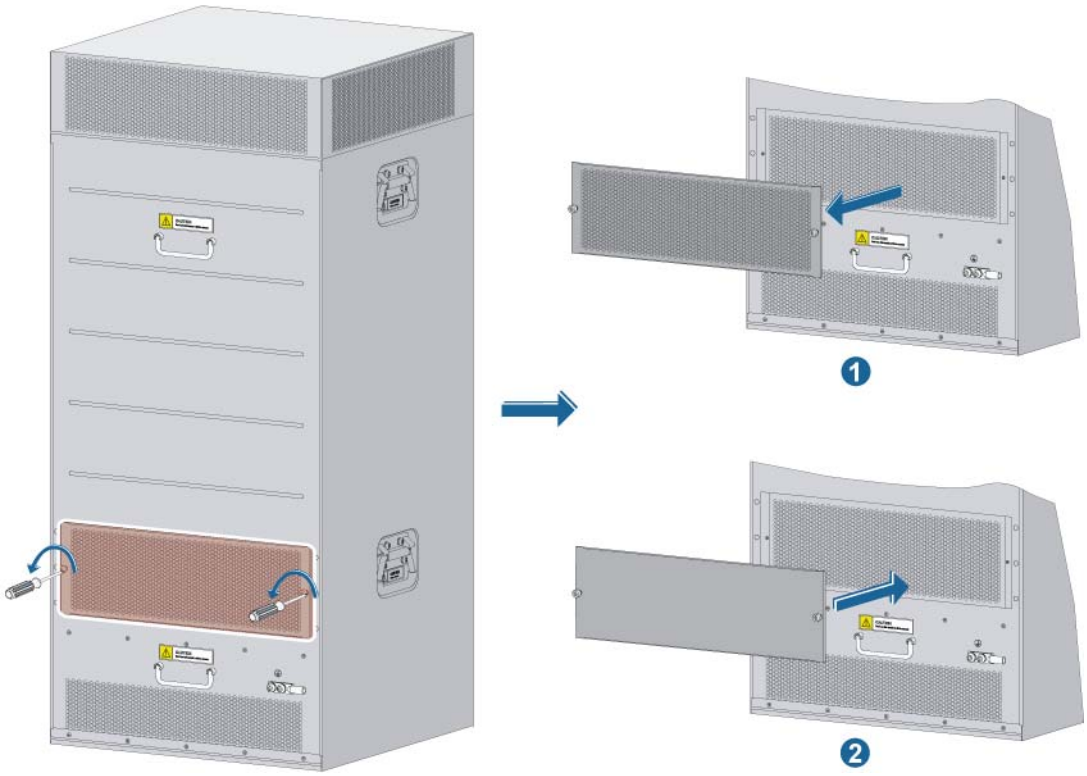
An impedance carrier is shipped with the A8808 only. You can install the impedance carrier at the rear of the chassis (where an air filter is located) to block the airflow from entering the rear of the chassis.

Install an impedance carrier for routers that have front-to-rear airflow, as shown in Figure 7.

To install an impedance carrier:

1. Loosen the captive screws on the air filter to remove the air filter.
2. Install the impedance carrier, and fasten the captive screws on the impedance carrier.

Figure 7 Installing an impedance carrier



Installing the router to a rack

CAUTION:

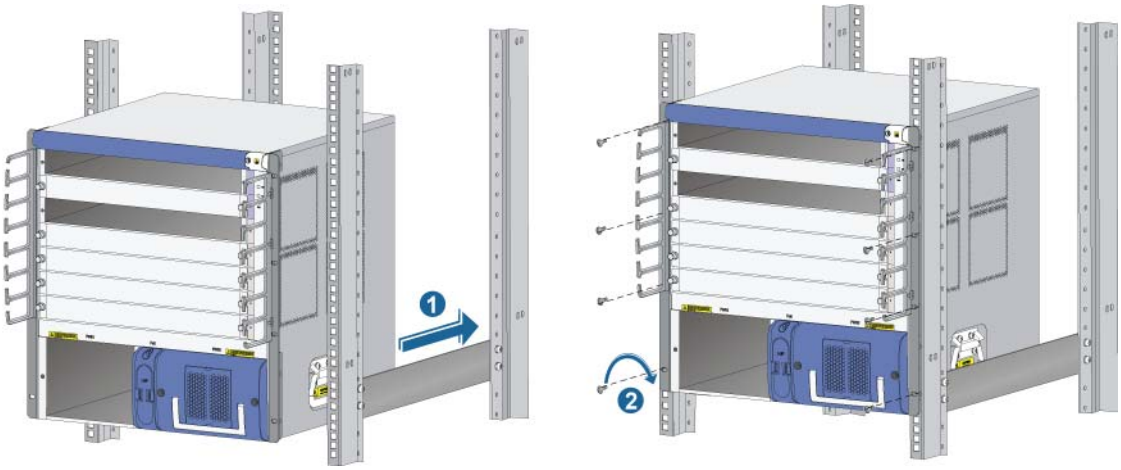
- Make sure you have installed a rack shelf or slide rails on the rack for supporting the router, and the rack shelf or the slide rails are sturdy enough to support the weight of the router chassis and all accessories. Do not install the router to the rack using only mounting brackets.
- To install multiple routers on the rack, mount the heaviest router at the bottom of the rack.

To mount the router in the rack:

1. Use several people to place the router on the rack shelf or slide rails, and then slide the router into the rack until the mounting brackets on the router touch the front rack posts.
2. Fasten the mounting brackets to the rack posts with mounting screws, as shown in Figure 8. If the screw holes on the mounting brackets cannot align with the cage nuts on the rack, verify

that the bottom edge of the slide rail aligns with the middle of the narrowest metal area between holes, and that the cage nuts are installed in the correct holes.

Figure 8 Installing the router in a standard 19-inch rack



Verifying the installation

Use the following checklist to make sure the router has been installed correctly.

Table 6 Installation checklist

Item	Result		Remarks
	Yes	No	
Mounting brackets are firmly attached to the router.			
The router is installed in the correct position.			
Mounting brackets on the router are firmly attached to the rack.			
There is enough space for heat dissipation around the router.			

Grounding the router

⚠ WARNING!

For the safety of operators and equipment, ground the router securely. Make sure the resistance reading between the router chassis and the ground is less than 1 ohm. Most racks are equipped with a grounding strip. You can connect the yellow-green grounding cable of the router to the grounding strip.

Connect the grounding cable to the earthing system in the equipment room. Do not connect it to a fire main or lightning rod.

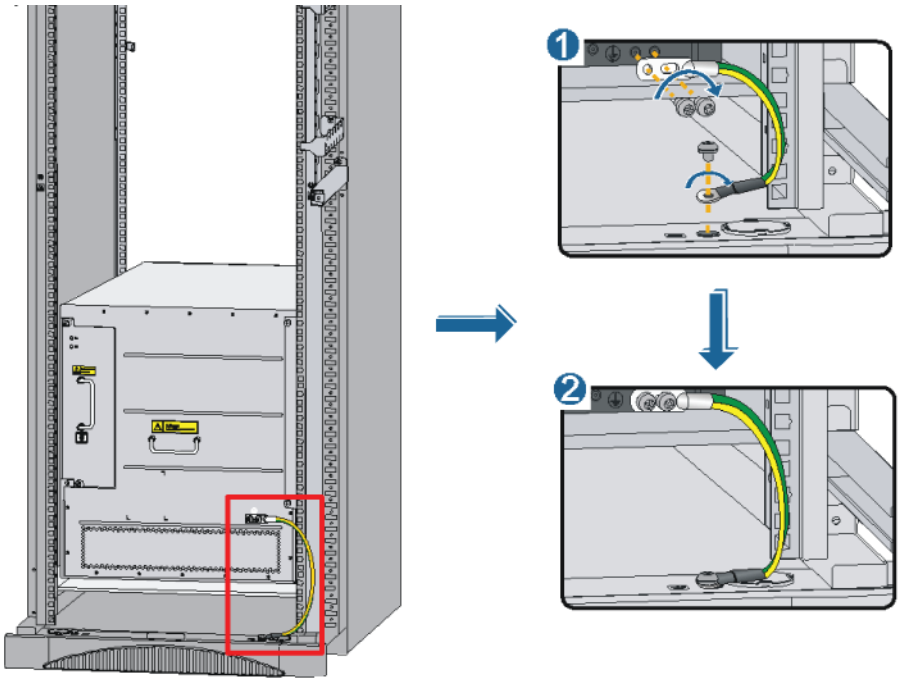
The positions of the grounding terminals on the A8805, A8808, and A8812 are similar. The following procedure uses the A8805 as an example.

To connect the grounding cable:

1. Remove the grounding screw from the router chassis, as shown in Figure 9.
2. Put the supplied OT terminal of the grounding cable on the grounding screw. Use the supplied grounding cable (CAT 6 cable with dual-hole OT terminals).

3. Insert the grounding screw into the grounding hole and tighten the screw.
4. Connect the other end of the grounding cable to the grounding strip of the rack in the same way.

Figure 9 Connecting the grounding cable



If there is no grounding point on the rack, you can attach the grounding cable to a grounding strip. The installation procedures are similar.

Installing the power system

CAUTION:

Hold a power supply by the bottom when moving it. Never attempt to lift a power supply by its handle because the handle is not designed to support weight. Doing so might result in bodily injury or damage to the power supply.

The router supports both AC and DC power supply modes. You can select either AC or DC power supply mode as needed. 1+1 redundancy is recommended.

- **DC power supply**—Includes NEPS2000-D and NEPS3500-D models.
- **AC power supply**—One or two AC power supplies are installed in the AC power frame NEPS3500-A.

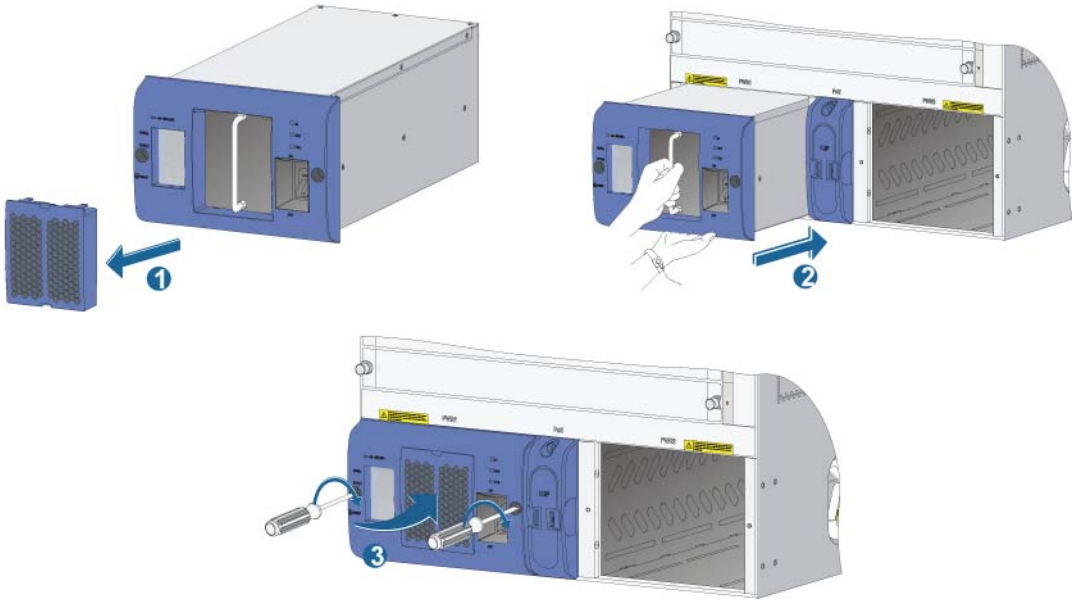
To prepare for installation:

1. Put on an ESD-preventive wrist strap and make sure it is properly grounded.
2. Make sure the power switch of the power supply is in the OFF position.
3. Remove the blank panel (if any) from the slot to be used.

Installing a DC power supply

1. Remove the air filter frame of the power supply and gently pull the DC power supply handle out.
2. Holding the handle of the power supply with one hand and supporting the bottom of the power supply with the other hand, push the power supply slowly along the slide rails until it makes close contact with the backplane, as shown in Figure 10.
3. Fasten the mounting screws on the power supply panel with a Phillips screwdriver.
4. Cover the power supply with the removed air filter frame.

Figure 10 Installing a DC power supply



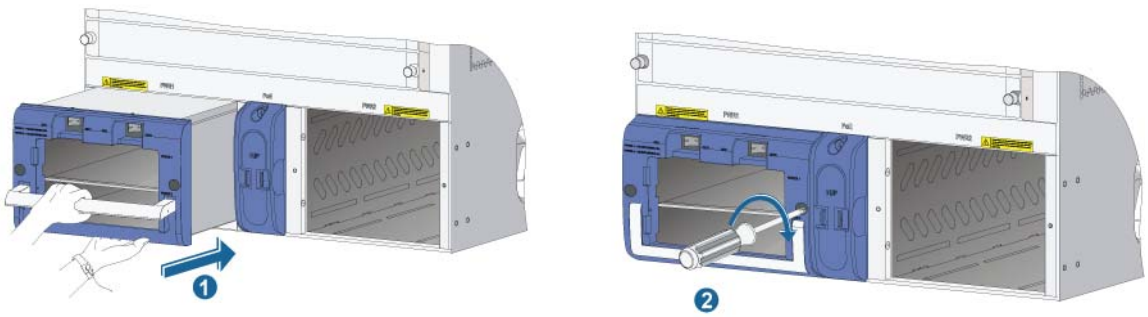
Installing an AC power supply

Installing a NEPS3500-A AC power frame

For a router that requires power supply redundancy, install the same number of power supplies in the two power frames.

1. Push the power frame slowly along the slide rails until it makes close contact with the backplane.
2. Fasten the mounting screws on the power frame panel with a Phillips screwdriver.

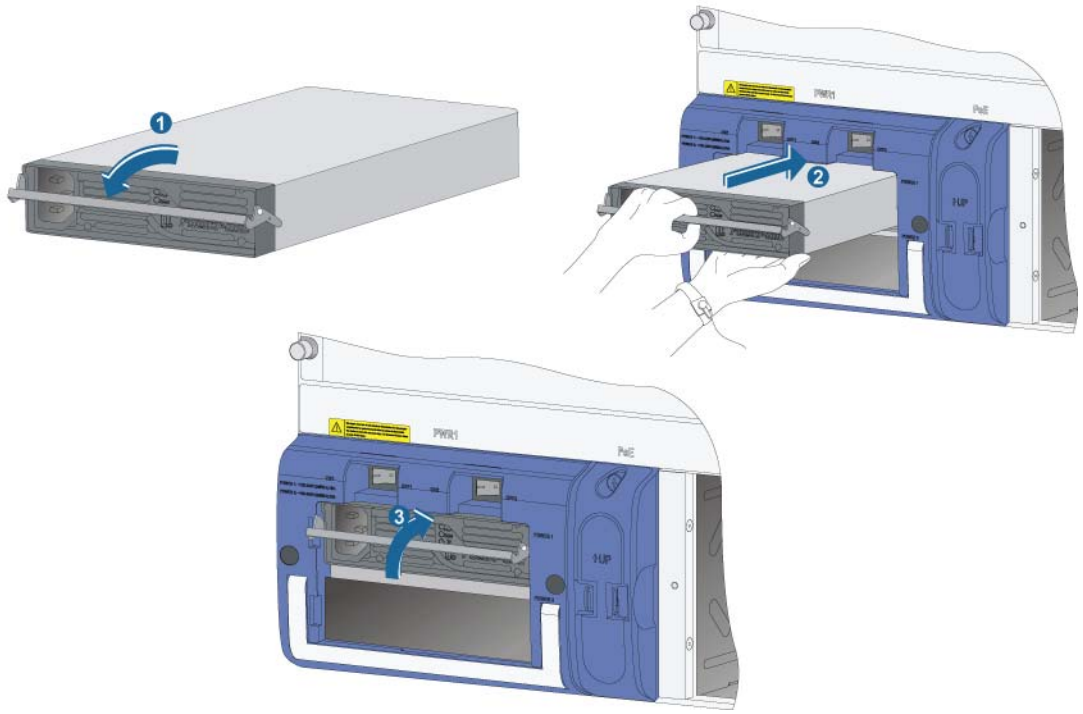
Figure 11 Installing a NEPS3500-A power frame



Installing an NEPS1800-A AC power supply

1. Pull the handle of the power supply downward to the unlock position.
2. Gently push the power supply into the AC power frame (NEPS3500-A) until the rear side of the power supply makes close contact with the power frame backplane.
3. Push the handle upward so that it locks the power supply in place.

Figure 12 Installing an AC power supply



Installing a card

All cards (excluding subcards) for the routers are hot-swappable.

You install MPUs and LPUs in the same way.

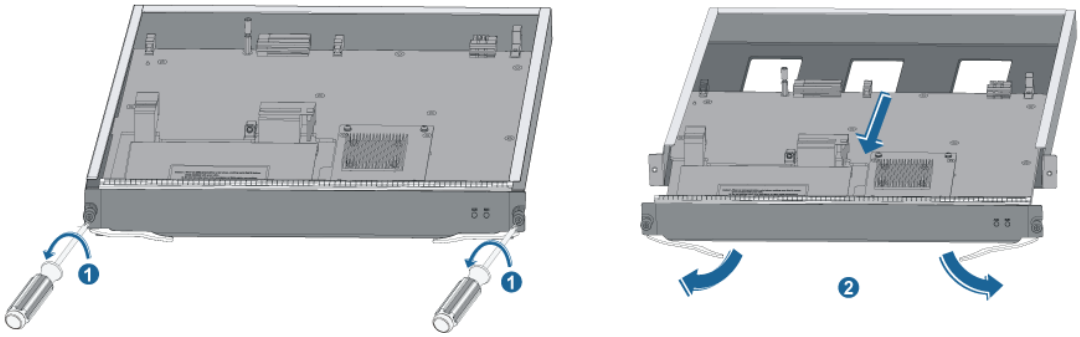
To prepare for installation:

1. Put on an ESD-preventive wrist strap and make sure it is properly grounded.
2. Remove the blank panel (if any) from the slot to be used. Keep the blank panel and protection cover for future use
3. Prepare the card to be installed.

To install a card:

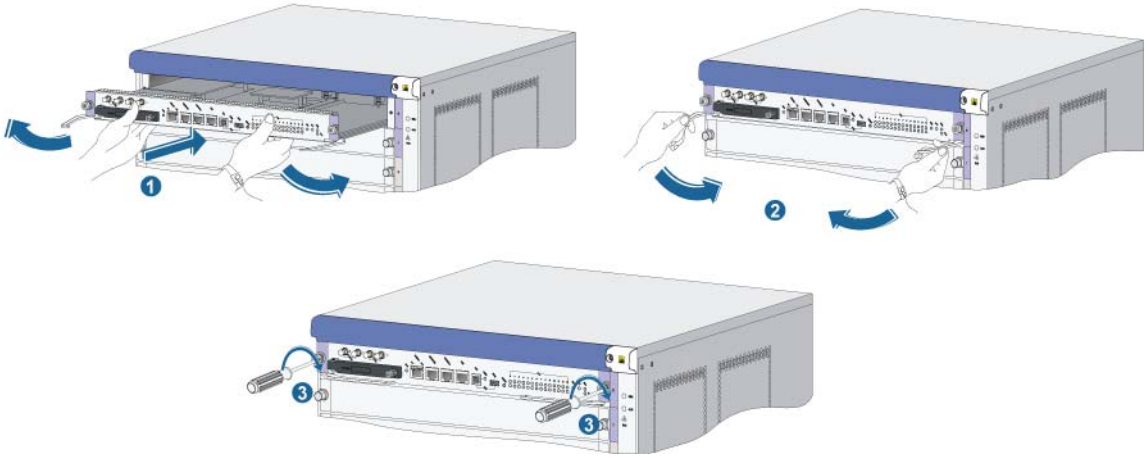
1. Remove the protection cover before installing the card:
   a. Put on an ESD-preventive wrist strap, and then use a Phillips screwdriver to loosen the captive screws that fasten the card to the protection cover.
   b. Gently pull the card out of the protection cover, as shown in Figure 13.

Figure 13 Removing the protection cover



2. Move the ejector levers of the card outward. Supporting the bottom of the card with both hands, slowly push the card into the slot along the slide rails.
3. Push the ejector levers inward to ensure close contact between the card and the backplane.
4. Position the screws in the holes and fasten them with a screwdriver to attach the card.

Figure 14 Installing a card



Installing an SPE subcard

CAUTION:

Do not install a subcard to the SPE card when the router is powered on.

This section describes how to install a subcard to an SPE card. The installation of an SPE card is the same as a common card. For more information, see "Installing a card"

The subcards are not hot-swappable. You can install a subcard using one of the following methods:

- Power off the router and install the subcard to the SPE card on the router.
- When the router is powered on, install the subcard to the SPE card that has not been installed, and then install them to the router.

To prepare for installation:

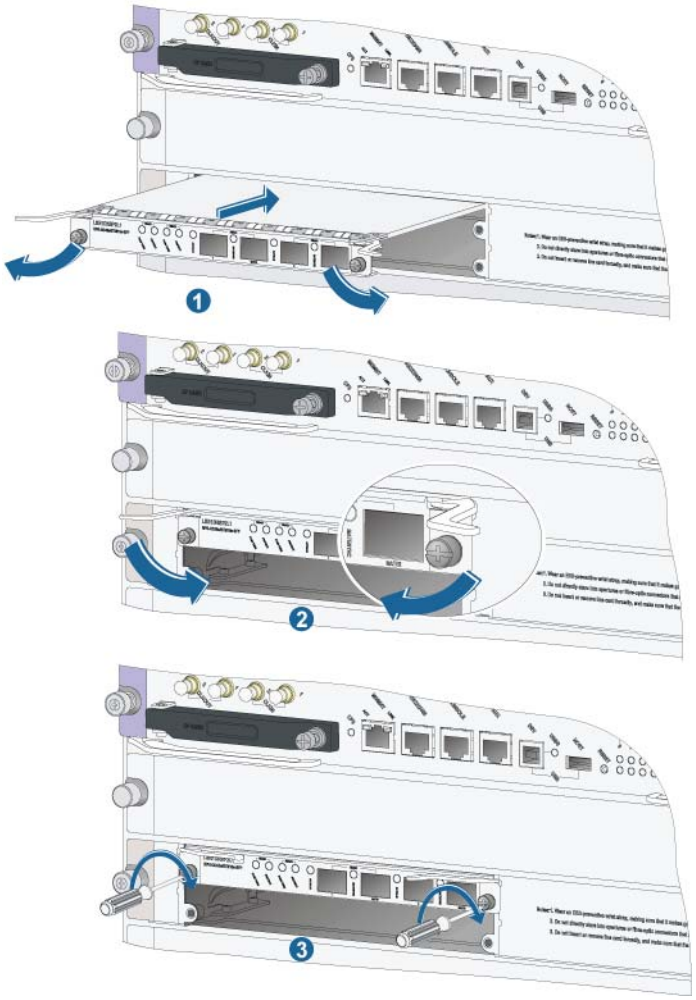
1. Put on an ESD-preventive wrist strap and make sure it is properly grounded.
2. Make sure the router is powered off and installed with the SPE card.

3. Remove the blank panel (if any) from the slot to be used on the SPE card.
4. Unpack the subcard.

To install a subcard:

1. Turn the ejector levers of the subcard outward simultaneously with both hands, and then slide the subcard (with the right side up) straight into the SPE card along the slide rails until the ejector levers touch the panel of the SPE card, as shown in Figure 15.
2. Push against the front panel of the subcard. When the front panel is close enough to the SPE card, pivot the ejector levers of the subcard inward with both hands so that the front panel is flush with the panel of the SPE card.
3. Use a Phillips screwdriver to fasten the mounting screws on the subcard.

Figure 15 Installing a subcard



Connecting power cables

Check the following items before connecting power cables:

- For lightning protection, the AC power should be routed through an external lightning device into the router. For more information, see "Lightning protection."
- The power switch on the power supply is in the OFF position.

Connecting an AC power cable

CAUTION:

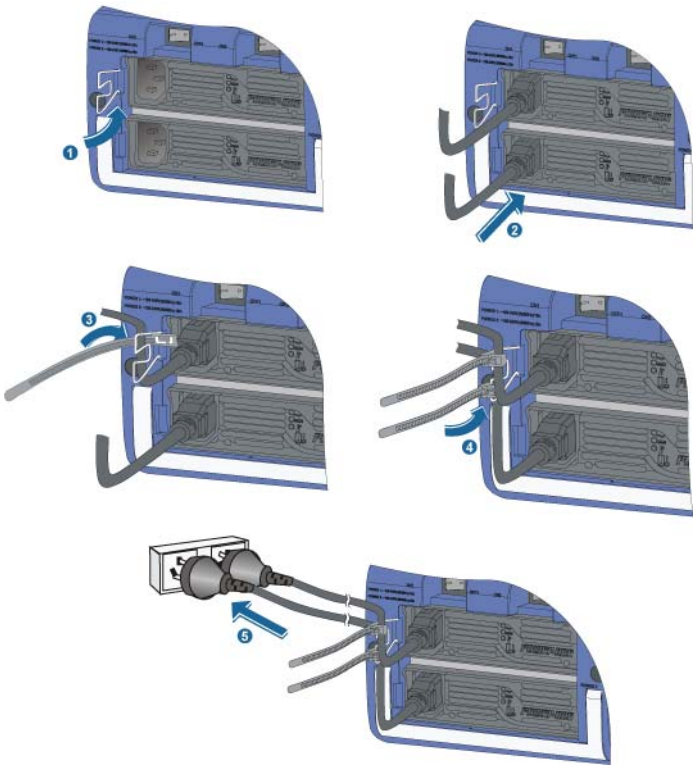
NEPS3500-A requires a 16 A power cable (AC), so you must use a 16 A busbar and make sure the AC power source can provide enough power.

The following procedure uses the AC power supply that comprises one 3500 W AC power frame and two 1800 W power supplies to show how to install AC power cables.

To connecting an AC power cable:

1. Insert the ends of the bail latch into the holes on the left side of the upper power supply.
2. Connect one end of the AC power cable to the AC receptacle on the module.
3. Use a wiring tie through a notch of the bail latch, and bend the power cable so that the wiring tie can bind the power cable with the bail latch.
4. Repeat steps 2 and 3 to bind another power cable with a wiring tie through the other notch.
5. Connect the other end of the AC power cable to the external power supply system.

Figure 16 Connecting a NEPS3500-A AC power cable



Connecting DC power cables

The DC power cables for the NEPS2000-D and NEPS3500-D are connected in the same way. The procedure in this section uses the NEPS2000-D.

WARNING!

To protect operators from being shocked, install the protection cover over the DC terminal block immediately after you connect the power cables.

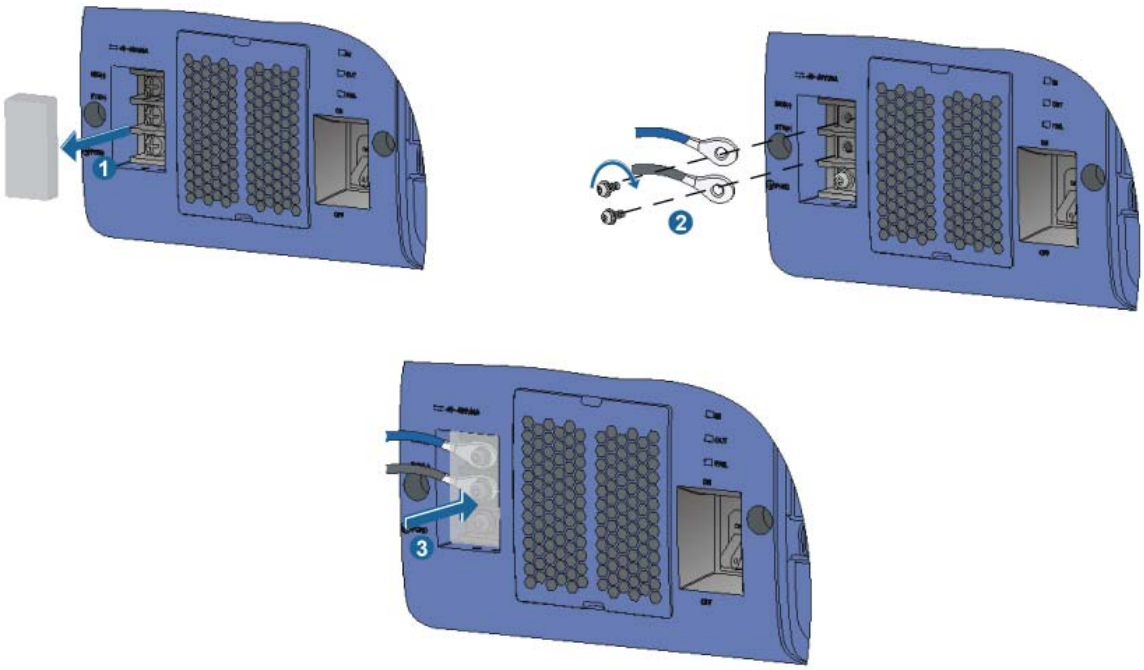
To connect the DC power cables:

1. Remove the protection cover of the DC terminal block from the DC power supply.
2. Loosen the fastening screws on the top two terminals with a Phillips screwdriver.
3. Connect one end of the blue –48 VDC power cable to the negative terminal (–) on the power supply and fasten the screw. Connect the other end of the cable to the negative –48 V terminal (–) on the power source.

   The –48 VDC cable is marked with a minus sign (–).
4. Connect one end of the black DC power cable to the RTN (+) terminal on the power supply and fasten the screw. Connect the other end of the cable to the RTN (+) terminal on the power source.

   The black DC power cable is marked with a plus (+) sign.
5. Put the protection cover over the DC terminal block.

Figure 17 Connecting DC power cables



Verifying the installation

⚠ WARNING!

Before verifying the installation, make sure you have turned off the power to avoid bodily injury and router damage.

Use the following checklist to make sure the router has been installed correctly.

Table 7 Installation checklist

Item	Result		Remarks
	Yes	No	
The grounding cable is grounded correctly.			
Power supplies are installed correctly and firmly seated.			
Power cables are connected correctly.			
MPUs are installed correctly and have close contact with the backplane.			
LPUs and subcards are installed correctly and have close contact with the backplane.			

Connecting the router to the network

Logging in to the router

The most common way to log in to a router is through the console port. It is also the prerequisite to configuring other login methods.

Connecting the console cable

A console cable is an 8-core shielded cable, with a crimped RJ-45 connector at one end for connecting to the console port of the router, and a DB-9 female connector at the other end for connecting to the serial port on the console terminal, as shown in Figure 18.

Figure 18 Console cable

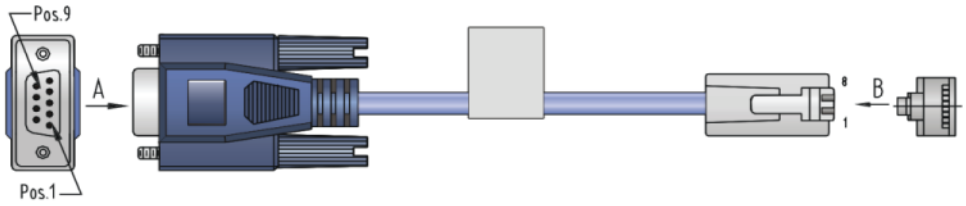
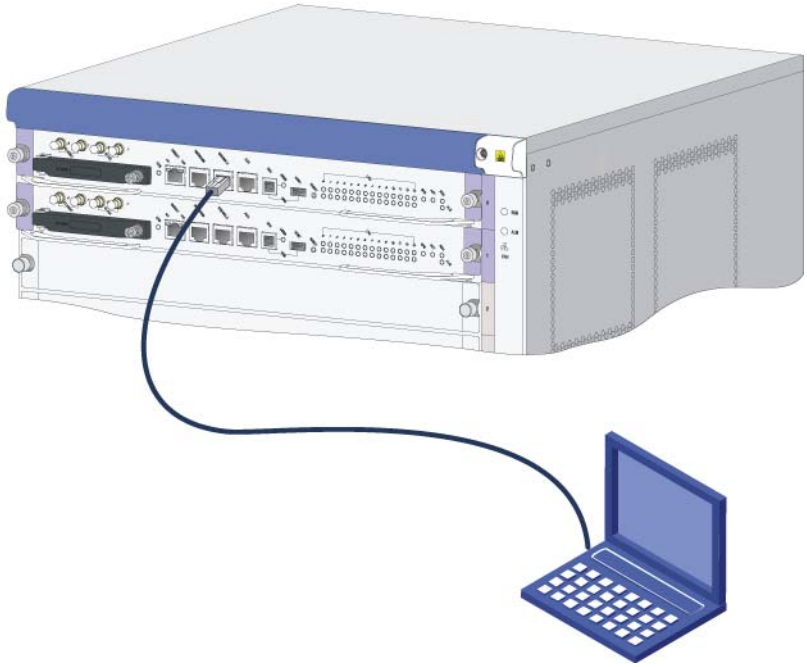


Table 8 Console cable pinouts

RJ-45 pin	Signal	DB-9 pin	Signal
1	RTS	8	CTS
2	DTR	6	DSR
3	TXD	2	RXD
4	CD	5	SG
5	GND	5	SG
6	RXD	3	TXD
7	DSR	4	DTR
8	CTS	7	RTS

Figure 19 Connecting the router and the PC through the console port



To connect the console cable:

1. Connect the DB-9 connector of the console cable to the serial port of a PC or terminal.
2. Connect the RJ-45 connector of the console cable to the console port of the MPU of the router.
3. When you remove the console cable, first unplug the RJ-45 end, and then unplug the DB-9 end.

Setting up a configuration environment

1. Launch a terminal emulation utility (such as HyperTerminal in Windows XP/Windows 2000). Select **Start** > **All Programs** > **Accessories** > **Communications** > **HyperTerminal** to access the HyperTerminal window.

   The **Connection Description** dialog box appears.

Figure 20 Connection Description dialog box for HyperTerminal

2. Enter the name of the new connection in the **Name** box, and then click **OK**.
   The system displays the interface, as shown in Figure 21.

Figure 21 Selecting a port for the HyperTerminal connection

3. Select a port from the **Connect using** list, and then click **OK**.
4. Set the **Bits per second** to **9600**, **Data bits** to **8**, **Parity** to **None**, **Stop bits** to **1**, and **Flow control** to **None**, and click **OK**.

Figure 22 Setting the serial port parameters

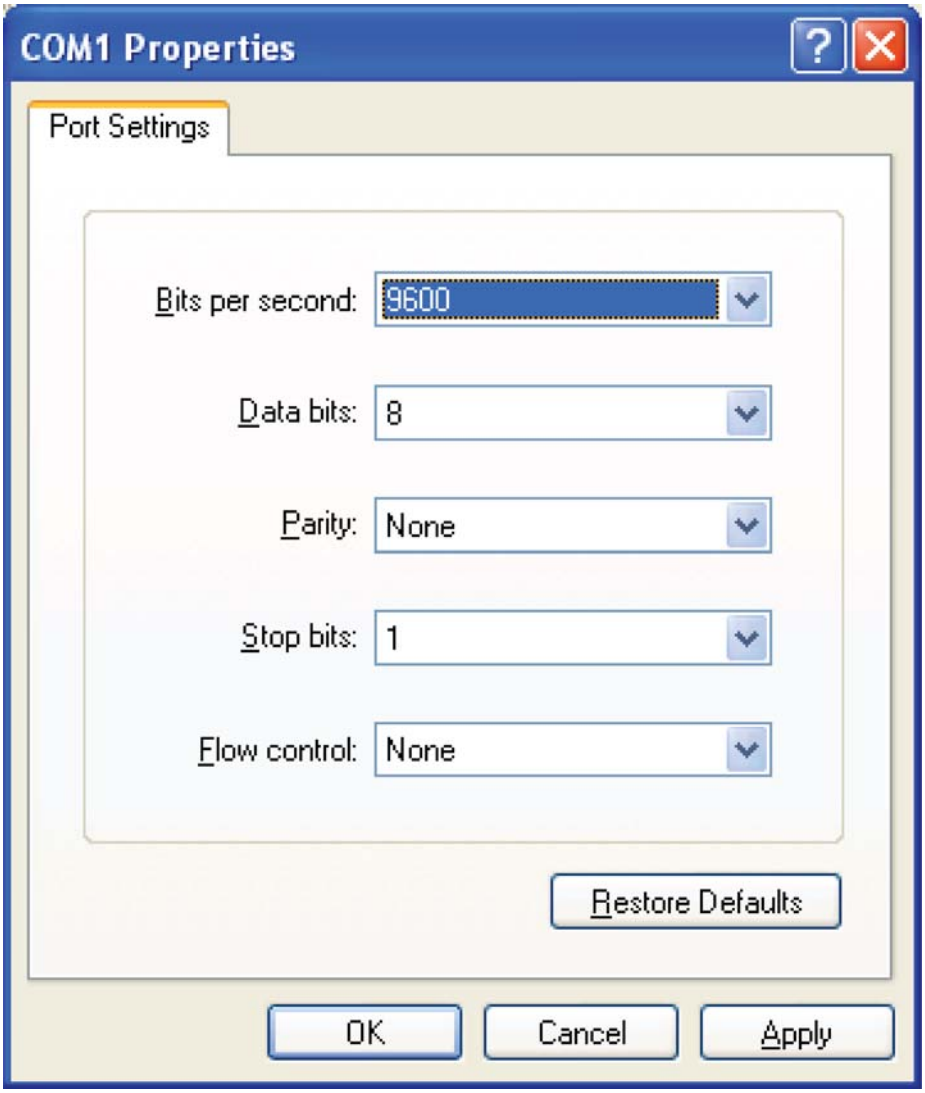
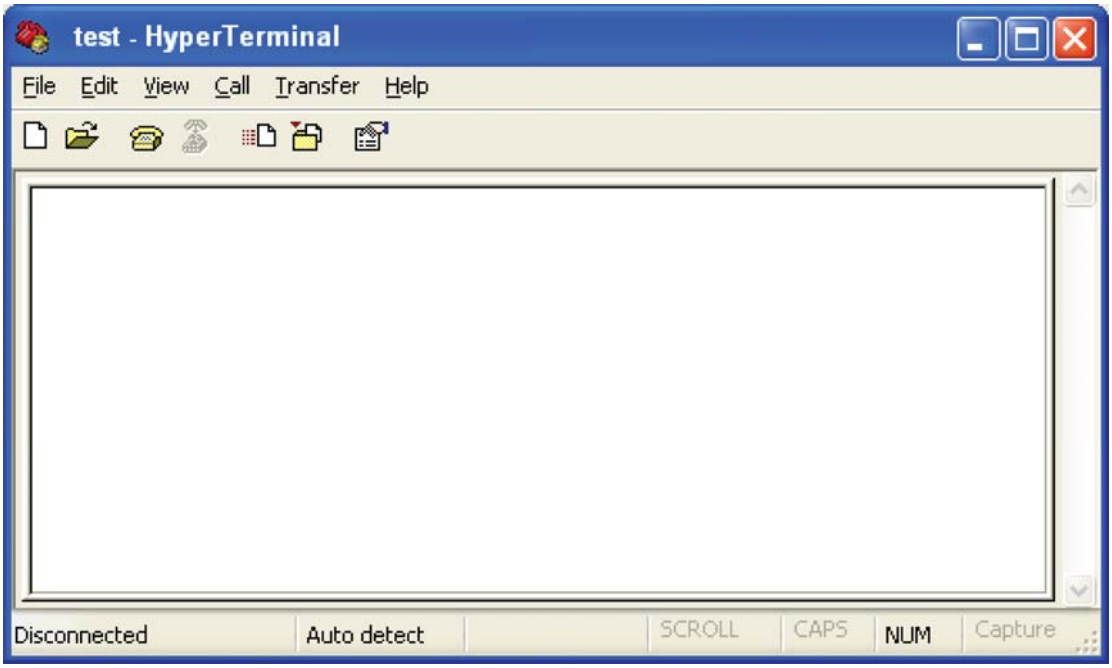


Figure 23 HyperTerminal window

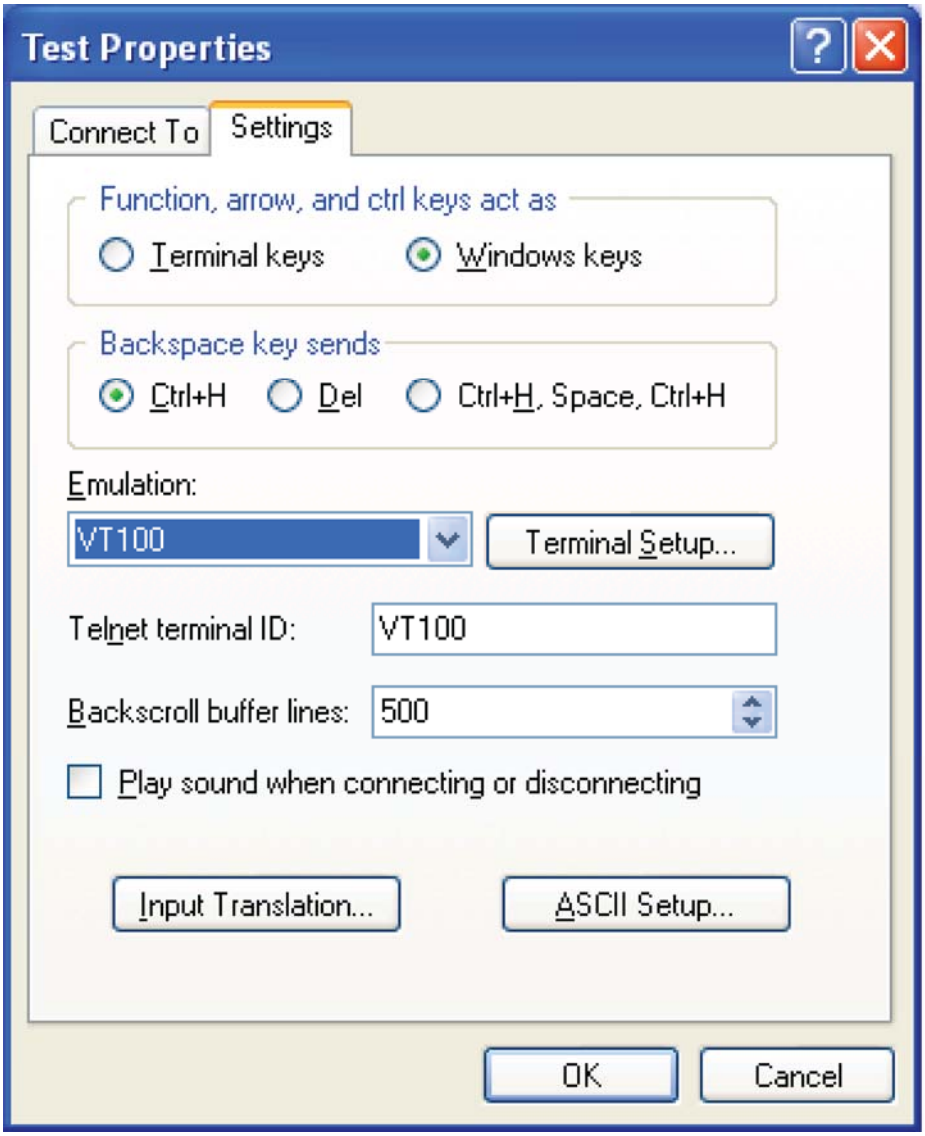


5. Select **File** > **Properties** in the HyperTerminal window.
6. On the **Settings** tab, select **VT100** for terminal emulation, and click **OK**.

NOTE:

HP recommends that you select the **Windows keys** option.

Figure 24 Setting the terminal emulation parameters



Powering on the router

CAUTION:

Before powering on the router, locate the power switch in the equipment room so that you can disconnect the power supply promptly in case of an emergency.

Before powering on the router, confirm the following:

- The interface cables, power cables, and grounding cable are connected correctly.
- The power outlet voltage is the same as indicated on the router label.
- The console cable is correctly connected, the console terminal or PC is powered on, and the terminal parameters are configured properly.

To power on the router:

1. Turn on the power switch of the power source providing power to the router.

2. Turn on the power switch on the router.

Before the router is powered on, the following information is displayed:

```
DDR2 SDRAM test successful.
System is starting...
Booting Normal Extend BootWare
The Extend BootWare is self-decompressing.....................
Done!
********************************************************************************
*                                                                              *
*                   HP A8800 BootWare, Version 1.10                          *
*                                                                              *
********************************************************************************
Copyright (c) 2010-2011 Hewlett-Packard Development Company, L.P.
Compiled Date       : Apr 22 2011
CPU Type            : MPC8548E
CPU L1 Cache        : 32KB
CPU L2 Cache        : 512KB
CPU Clock Speed     : 1000MHz
Memory Type         : DDR2 SDRAM
Memory Size         : 1024MB
Memory Speed        : 400MHz
BootWare Size       : 4MB
Flash Size          : 128MB
cfa0 Size           : 247MB
NVRAM Size          : 1024KB
BASIC CPLD Version  : 001F
EXTEND CPLD Version : 001F
PCB Version         : Ver.B
```

The router initiates the POST and the results are displayed at the console terminal.

```
Board self testing.......................
Board steady testing...                          [ PASS ]
Board SlotNo...                                  [   0  ]
Subcard exist testing...                         [ PASS ]
DX246  testing...                                [ PASS ]
PHY88E1111  testing...                           [ PASS ]
CPLD1 testing...                                 [ PASS ]
CPLD2 testing...                                 [ PASS ]
NS16550 register testing...                      [ PASS ]
The device's Mac address...                      [00:23:89:D4:00:00]
CF Card testing...                               [ PASS ]
BootWare Validating...
Press Ctrl+B to enter extended boot menu...
```

When the POST is complete, the router boots the applications. The following information appears on the terminal screen (only a portion is shown in this example):

```
Starting to get the main application file--cfa0:/A8800.BIN!..
The main application file is self-decompressing.........................
System application is starting...
```

```
kbd->bi_immr_base = 0xff700000.
Starting kernel at 0x10000 ...
Now beginning to initialize system
User interface con0 is available.
```

After the router completes booting the applications, the following information appears on the terminal screen:

```
Press ENTER to get started.
```

3. Press **Enter** to begin configuring the router at the prompt:

```
<HP>
```

NOTE:

- The router displays a CLI. For more information about the CLI, see *HP A8800 Routers Fundamentals Configuration Guide*.
- The output depends on your router model.

Verifying router operation (recommended)

HP recommends that you verify the following after the router is powered on:

- The cooling system is working. You should be able to hear fan rotation noise and feel air being blown out.
- All LEDs are functioning correctly.

Table 9 ED status when the router is operating correctly

Part	LED	Name	Status
MPU	MPU status LED	SFC	Steady green
		ACT	Active MPU: Steady green Standby MPU: Off
		RUN	Flashing green
	LPU status LED	RUN	Flashing green
Power supply	Power supply input/output LED	IN	Steady green
		OUT	Steady green
Fan tray	Fan tray status LED	RUN	Steady green
		ALM	Off

For the card LED description, see "LEDs."

Connecting the router to the network

You can connect the router to the network using the following cable types:

- AUX cable
- Ethernet twisted pair
- Optical fiber

Connecting through an AUX cable

You need an AUX cable when configuring a router using a remote dial-up modem.

An AUX cable is an 8-core shielded cable. At one end of the cable is an RJ-45 connector. At the other end is a DB-9 (male) connector. An AUX cable is the same as a console cable. For more information, see Figure 18 and Table 8.

To connect the AUX port:

1. Plug the RJ-45 connector of the AUX cable into the AUX port of the router.
2. Plug the DB-9 (male) connector at the other end into the serial port of the modem.

Connecting through an Ethernet twisted pair cable

The 10/100/1000Base-T copper ports of the router support MDI/MDI-X autosensing. They are connected to the network through Category 5 (or higher) twisted pairs equipped with RJ-45 connectors.

No Ethernet twisted pair cables are shipped with the router. Prepare them yourself.

To connect a 10/100/1000Base-T port:

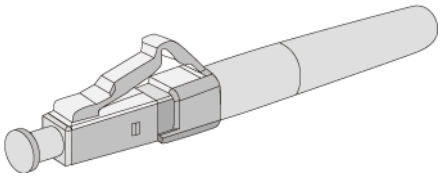
1. Plug one end of an Ethernet twisted pair cable into the copper Ethernet port (RJ-45 port) to be connected on the router.
2. Plug the other end of the cable into the RJ-45 port of the peer device.

Connecting through an optical fiber

Use an optical fiber to connect an optical fiber port (for example, XFP fiber port or SFP fiber port) on the router to the network. You must install a transceiver module to the router, and then insert the fiber connector into the module.

This section describes only the LC connector.

Figure 25 LC connector



Follow these precautionary steps:

1. When selecting a fiber network facility, make sure the type of the connector and the fiber match the adopted optical port.
2. Install the dust cover if the optical port is not connected to a fiber connector.
3. Never stare at the optical port directly. Invisible rays may be emitted from the optical port if the optical port is not connected to a fiber connector or the dust cover is removed.
4. Never bend or curve a fiber when connecting it.

Installing a transceiver module

CAUTION:

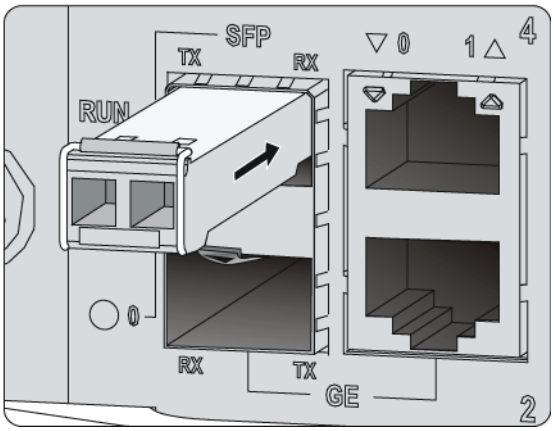
During installation, do not touch the golden finger of the SFP module.

The installation procedures for an XFP module and SFP module are similar. The following procedure uses an SFP module as an example.

To install an SFP module:

1. Put on an ESD-preventive wrist strap, and make sure it makes good skin contact, and is well grounded.
2. Unpack the SFP module. Close the clasp by pushing it up over the SFP module, and then gently insert the SFP module into the interface slot until it clicks into place, as shown in Figure 26.

Figure 26 Installing an SFP module



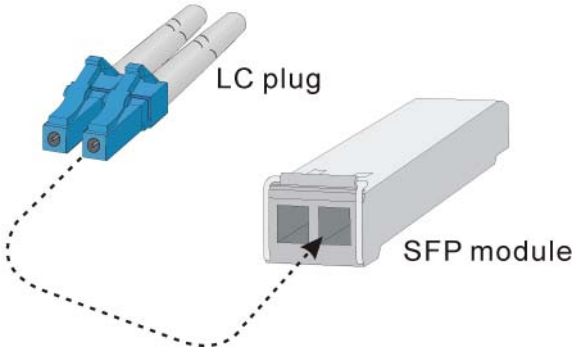
IMPORTANT:

- Do not remove the dust plug of the SFP module port before installing an optical fiber.
- For an SFP module installed with an optical fiber, remove the fiber before you install the SFP module into the slot.

Connecting an optical fiber

1. Put on an ESD-preventive wrist strap, and make sure it is well grounded.
2. Remove the protective cap from the fiber connector, and use dust free paper and absolute alcohol to clean the end face of the fiber connector.
3. Connect one end of the fiber to the SFP module of the router.
4. Connect the other end of the fiber to the peer device.

Figure 27 Connecting an optical fiber to an SFP module



Installing an FMT (optional)

The FMT is installed in a cabinet for winding redundant fibers between the router and other devices.

Confirm the following prerequisites:

- The cabinet is attached.
- The router is installed.

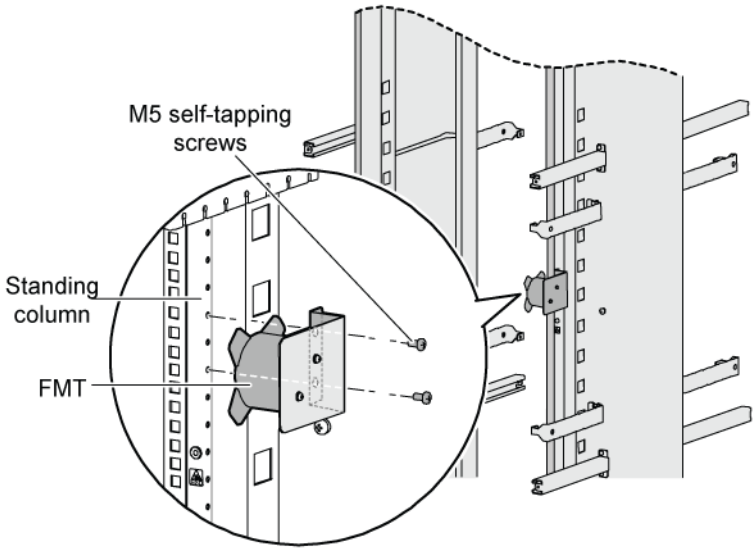
The installation involves the following materials:

- FMT
- M5×10 self-tapping screws (two screws for one FMT)

To install the FMT:

1. Align the FMT and the installation holes on the column of the cabinet.
2. Use a Phillips screwdriver to attach each FMT with two M5×10 self-tapping screws.

Figure 28 Installing the FMT



Cable routing recommendations

CAUTION:

Do not bind cables at the air exhaust vent to prevent the cables from aging too fast. For more information, see "Cable management."

Interface cables and power cables should be routed separately. Proper cable routing can improve efficiency by facilitating installation and removal of fan trays, the PEM, and other components.

Follow these recommendations when you route cables:

- Interface cables are routed through the cable management brackets on the left and right sides of the chassis and bound at cabling racks on chassis sides, depending on the available equipment room condition.
- Put all data signal cable adapters neatly under the chassis (instead of any places outside the chassis in case of unexpected damages).
- The power cables run along the left-rear of the chassis and out of the chassis either from the chassis top or the raised floor depending on the equipment room conditions (power distribution cabinet, lightning protection box, and connector strip, etc.) of the exchange office.
- Attach cables as close to the router as possible. The cables between the attachment point and router interfaces must be bound loosely.
- Long cables can be bound with cable ties. Do not bind cables at the air exhaust vent to prevent the cables from aging too fast. For more information, see "Appendix E Cable management."
- To identify cables, you can stick labels on them. For more information, see "Appendix F Engineering labels for cables."

Hardware management

This chapter describes the hardware management functions of the router.

Displaying electrical label data

Electrical label data is also called permanent configuration data or archive information, which is written to the storage component of a card during device debugging or testing. The information includes name of the card, card serial number, and vendor name.

Use the **display device manuinfo** command to display the electronic label data for your router, including the card name, serial number, MAC address, manufacturing date, and vendor name.

Display the electrical label data for the card in slot 3 on your router.

```
<Sysname> display device manuinfo slot 3
Slot 3:
DEVICE_NAME           : SPC-1010-II
DEVICE_SERIAL_NUMBER  : 210231A0E50103000002
MAC_ADDRESS           : 000f-e200-5600
MANUFACTURING_DATE    : 2011-02-28
VENDOR_NAME           : HP
 Slot 3 Subslot 1:
DEVICE_NAME           : PIC-TCP8L
DEVICE_SERIAL_NUMBER  : 210231A85JH105000015
MAC_ADDRESS           : NONE
MANUFACTURING_DATE    : 2010-05-24
VENDOR_NAME           : HP
```

NOTE:

The output depends on your router model.

Displaying card information

Use the **display device** command to display your router's card information, including the slot number, card type, card status, and software version.

Display summary information for all cards on your router.

```
<Sysname> display device
Slot No.   Brd Type        Brd Status   Software Version
 0         SR02SRP2F3      Master       A8800-CMW520-R3342
 1         NONE            Absent       NONE
 2         NONE            Absent       NONE
 3         SPE-1010-II     Normal       A8800-CMW520-R3342
   Sub1    PIC-TCP8L       Normal
 4         NONE            Absent       NONE
 5         NONE            Absent       NONE
```

```
6           NONE              Absent        NONE
```

Table 10 Command output

Field	Description
Slot No.	Slot number of a card.
Brd Type	Hardware type of a card: Specific card model, such as SPE-1010-II, which is the same as the mark on the card. • **NONE**—No card is in the slot. • **UNKNOWN**—The card is not supported by the software version and cannot start normally.
Brd Status	Card status: • **Absent**—No card is in the slot. • **Master**—The card is an AMB. • **Slave**—The card is a SMB. • **Normal**—The card is an interface card and operates properly. • **Fault**—The card in the slot has not started or fails. • **Off**—The card is not powered on.
Software Version	Software version of the current card: • **Specific software version**—The software version of the router. • **NONE**—No card is in the slot. • **Mismatched**—The software version does not support the card and thus cannot be uploaded.

Rebooting the router

CAUTION:

- Router reboot can interrupt network services.
- To avoid data loss, use the save command to save the current configurations before a reboot.
- Use the display startup and display boot-loader commands to check that you have correctly set the startup configuration file and the main system software image file.

You can reboot the router in one of the following ways to recover from an error condition:

- Reboot the device immediately at the CLI.
- At the CLI, schedule a reboot to occur at a specific time and date or after a delay.
- Power off and then re-power on the device. This method might cause data loss, and is the least preferred method.

Reboot at the CLI is also called hot start. It is mainly used to reboot a router in remote maintenance, without performing hardware reboot of the router.

For data security, if you reboot the router while the router is performing file operations, the router does not reboot.

The precision of the rebooting timer is 1 minute. One minute before the rebooting time, the router prompts "REBOOT IN ONE MINUTE" and reboots in one minute.

To reboot a router:

Step	Command	Remarks
1. Reboot a card, or the whole system immediately.	**reboot** [**slot** *slot-number*]	Optional. Available in user view. The precision of the rebooting timer is 1 minute. One minute before the rebooting time, the router prompts "REBOOT IN ONE MINUTE" and reboots in one minute. If you do not specify the **slot** keyword, or reboot the AMB, the **reboot** command reboots the router. If you are performing file operations when the router is to be rebooted, the system does not execute the **reboot** command for security purposes.
2. Enable the scheduled reboot function and specify a specific reboot time and date.	**schedule reboot at** *hh:mm* [*date*]	Optional. The scheduled reboot function is disabled by default. Available in user view
3. Enable the scheduled reboot function and specify a reboot waiting time.	**schedule reboot delay** { *hh:mm* | *mm* }	Optional. The scheduled reboot function is disabled by default. Available in user view

Displaying the router power supply system

Use the **display power-supply** command to display the power supply system of your router.

```
<Sysname> display power-supply verbose
Power  1    state: Normal
Power  2    state: Absent

Slot No.          Board Power Status
 0                POWER ON
 3                POWER ON
```

Table 11 Command output

Field	Description
Power x state:	State of power supply x: • **normal**—The power supply is normal. • **absent**—The power supply is not in position.
Slot No	Slot number of the card.
Board Power Status	Power supply status of the card: • **power on**—The card is properly supplied with power. • **power off**—The card is powered off due to user operation or over-temperature protection.

Configuring temperature alarm thresholds for a card

Use the following command to set temperature alarm thresholds for a card. When the temperature of a card exceeds a threshold, the router generates alarm signals.

To configure temperature alarm thresholds for a card:

Step		Command	Remarks
1.	Enter system view.	**system-view**	N/A
2.	Configure temperature alarm thresholds for a card.	**temperature-limit slot** *slot-number* **hotspot** *sensor-num LowerLimit WarningLimit* [*AlarmLimit*]	Optional.

Displaying temperature information for a router

Use the **display environment** command to display the temperature information of the sensors on the cards, including the current temperature and temperature thresholds.

Display the temperature information of the cards on the router.

```
<Sysname> display environment

System temperature information (degree centigrade):
---------------------------------------------------------------------------
Slot  Sensor    Temperature  LowerLimit  WarningLimit  AlarmLimit ShutdownLimit
   0  hotspot 1       39           0           70           85          N/A
   0  hotspot 2       40          20           80           95          N/A
   3  hotspot 1       55         -10           60           80          N/A
   3  hotspot 2       42          -5           65           85          N/A
```

Table 12 Command output

Field	Description
Slot	Slot number of a card.
Sensor	Temperature sensor, where "hotspot" indicates the hotspot temperature sensor.
Temperature	Current temperature.
Lower limit	Lower limit of temperature.
WarningLimit	Upper limit of temperature for warning.
AlarmLimit	Upper limit of temperature for alarming.
ShutdownLimit	Upper limit of temperature for shutting down the router (currently not supported).

Configuring in-service hardware failure diagnosis

A hardware failure may cause traffic forwarding failures and service interruption. To improve the automatic failure detection and handling capabilities of the router, you can configure in-service hardware failure diagnosis.

The in-service hardware failure diagnosis includes the detection for chips, cards, and the forwarding service, and automatic fix actions taken for the detected failures.

To configure in-service hardware failure diagnosis:

Step	Command	Remarks
1. Enter system view.	**system-view**	N/A
2. Enable in-service hardware failure detection and configure fix actions taken in case of hardware failures.	**hardware-failure-detection** { **chip** | **board** | **forwarding** } { **off** | **warning** | **reset** | **isolate** }	Required. The fix actions taken in case of hardware failures include: • **Off**—Takes no action. • **Warning**—Sends warning messages. • **Reset**—Resets the failed card. • **Isolate**—Shuts down the failed port, isolates the failed card, prohibits the failed card from loaded, or powers off the failed card to reduce the impact of the failure to the system. Currently, the router supports only **off** and **warning** operations. By default, the fix action taken for all hardware failures is **warning**.

After configuring in-service diagnosis, you can use the **display hardware-failure-detection** command to check the running information of the feature.

Displaying the operating state of a fan

Use the **display fan** command to display the operating state of all fans on your router.

```
<Sysname> display fan
 Fan  1 State: Normal
Fan  2 State: Normal
```

The output above shows that all fans of the router operate normally.

Displaying alarm information for a card

Use the **display alarm** command to display alarm information for a card.

```
<Sysname> display alarm
Slot  Level    Info
0     ERROR    Power 2 is absent.
0     ERROR    Slot 6 board state is faulty
```

Table 13 Command output

Field	Description
Level	Alarm severity. In descending order, the alarm severity levels include ERROR, WARNING, NOTICE, and INFO.

Field	Description
Info	Detailed alarm information.
Slot *n* board state is faulty.	Card *n* is faulty. The reason may be the card is booting or the card fails.

Verifying and diagnosing transceiver modules

Introduction to transceiver modules

There are two types of commonly used transceiver modules, as shown in Table 14. They can be further divided into optical transceiver modules and electrical transceiver modules based on transmission medium.

Table 14 Commonly used transceiver modules

Transceiver type	Application scenarios	Optical transceiver module?	Electrical transceiver module?
SFP	Generally used for 100M/1000M Ethernet interfaces, ATM, or POS 155M/622M/2.5G interfaces	Yes	Yes
XFP	Generally used for 10G Ethernet interfaces and 10 RPR interfaces	Yes	No

Verifying transceiver modules

To verify transceiver modules, you can use the following commands to view the key parameters of the transceiver modules, including transceiver module type, connector type, central wavelength of the laser sent, transfer distance, and vendor name.

To display transceiver module information:

Task	Command	Remarks
Display key parameters of the transceiver module in a specified interface.	**display transceiver interface** [*interface-type interface-number*]	Available for all transceiver modules.
Display part of the electrical label data for the transceiver module in a specified interface.	**display transceiver manuinfo interface** [*interface-type interface-number*]	Available for all transceiver modules.

Display the main parameters of the transceiver module plugged in interface GigabitEthernet 3/1/1.

```
<Sysname> display transceiver interface Gigabitethernet 3/1/1
GigabitEthernet3/1/1 transceiver information:
  Transceiver Type              : 1000_BASE_SX_SFP
  Connector Type                : LC
  Wavelength(nm)                : 850
  Transfer Distance(m)          : 550(50um),270(62.5um)
```

```
  Digital Diagnostic Monitoring : YES
  Vendor Name                   : HP
  Ordering Name                 : JD118B
```

Table 15 Command output

Field	Description
transceiver information	Transceiver information
Transceiver Type	Transceiver type
Connector Type	Type of connector: • Optical connectors, including SC (SC connector, developed by NTT) and LC (LC connector, 1.25 mm/RJ-45 optical connector developed by Lucent). • Other connectors, including RJ-45 and CX 4.
Wavelength(nm)	• **Optical transceiver module**—Central wavelength of the laser sent, in nm. If the transceiver module, for example, 10GBASE-LX4, supports multiple wavelengths, every two wavelength values are separated by a comma. • **Electrical transceiver module**—Displayed as N/A.
Transfer distance(xx)	Transfer distance, where xx represents km for single-mode transceiver modules and m for other transceiver modules. If the transceiver module supports multiple transfer medium, every two values of the transfer distance are separated by a comma. The corresponding transfer medium is included in the bracket following the transfer distance value. The following are the transfer media: • **9** μ—9/125 μ single-mode optical fiber • **50** μ—50/125 μ multi-mode optical fiber • **62.5** μ—62.5/125 μ multi-mode optical fiber • **TP**—Twisted pair • **CX4**—CX4 cable
Digital Diagnostic Monitoring	Whether the digital diagnosis function is supported: • **YES**—Supported • **NO**—Not supported
Vendor Name	Name of the vendor who manufactures or customizes the transceiver module.
Ordering Name	Transceiver module model.

Display part of the electrical label data for the transceiver modules in a specified interface.

```
<Sysname> display transceiver manuinfo interface Gigabitethernet 3/1/1
GigabitEthernet3/1/1 transceiver manufacture information:
  Manu. Serial Number  : XXXXXXXXXXXXXXXXX
  Manufacturing Date   : 2008-09-01
  Vendor Name          : HP
```

Table 16 Command output

Field	Description
Manu. Serial Number	Serial number of the transceiver module.
Manufacturing Date	Manufacturing date of the transceiver module.
Vendor Name	Name of vendor who customizes the transceiver module.

Diagnosing transceiver modules

The device provides the alarm function and digital diagnosis function for transceiver modules. When a transceiver module fails or inappropriately work, you can check for alarms present on the transceiver module to identify the fault source or examine the key parameters monitored by the digital diagnosis function, including the temperature, voltage, laser bias current, TX power, and RX power.

To display alarm information or fault detection parameters for a transceiver module:

Task	Command	Remarks
Display the current alarm information of the transceiver module in a specified interface	**display transceiver alarm interface** [*interface-type interface-number*]	Available for all transceiver modules.
Display the currently measured values of the detection parameters of the transceiver module in a specified interface	**display transceiver diagnosis interface** [*interface-type interface-number*]	Available for all transceiver modules.

Display the alarm information of the transceiver module plugged in GigabitEthernet 3/1/1.

```
<Sysname> display transceiver alarm interface GigabitEthernet 3/1/1
GigabitEthernet3/1/1 transceiver current alarm information:
  RX loss of signal
```

Table 17 Command output

Field	Remarks
SFP	
RX loss of signal	Receive (RX) signal is lost.
TX fault	TX fault.
RX power high	RX power is high.
RX power low	RX power is low.
TX power high	TX power is high.
TX power low	TX power is low.
TX bias high	TX bias current is high.
TX bias low	TX bias current is low.
Temp high	Temperature is high.
Temp low	Temperature is low.
Voltage high	Voltage is high.
Voltage low	Voltage is low.
Transceiver info I/O error	Transceiver information read and write error.
Transceiver info checksum error	Transceiver information checksum error.
Transceiver type and port configuration mismatch	Transceiver type does not match port configuration.
Transceiver type not supported by port hardware	Transceiver type is not supported on the port.

Field	Remarks
XFP	
RX loss of signal	RX signal is lost.
RX not ready	RX is not ready.
RX CDR loss of lock	RX clock cannot be recovered.
TX fault	TX fault.
TX not ready	TX is not ready.
TX CDR loss of lock	TX clock cannot be recovered.
Module not ready	Module is not ready.
APD supply fault	Avalanche Photo Diode (APD) supply fault.
TEC fault	Thermoelectric Cooler (TEC) fault.
Wavelength unlocked	Wavelength of optical signal exceeds the manufacturer's tolerance.
RX power high	RX power is high.
RX power low	RX power is low.
TX power high	TX power is high.
TX power low	TX power is low.
TX bias high	TX bias current is high.
TX bias low	TX bias current is low.
Temp high	Temperature is high.
Temp low	Temperature is low.
Voltage high	Voltage is high.
Voltage low	Voltage is low.
Transceiver info I/O error	Transceiver information read and write error.
Transceiver info checksum error	Transceiver information checksum error.
Transceiver type and port configuration mismatch	Transceiver type does not match port configuration.
Transceiver type not supported by port hardware	Transceiver type is not supported on the port.

Display the currently measured values of the fault detection parameters for the transceiver module plugged in interface GigabitEthernet 3/1/1.

```
<Sysname> display transceiver diagnosis interface Gigabitethernet 3/1/1
GigabitEthernet3/1/1 transceiver diagnostic information:
  Current diagnostic parameters:
    Temp(°C)  Voltage(V)  Bias(mA)  RX power(dBM)  TX power(dBM)
    36        3.31        6.13      -35.64          -5.19
```

Table 18 Command output

Field	Description
Transceiver diagnostic information	Fault detection information of the transceiver module plugged in the interface
Current diagnostic parameters	Current fault detection parameters
Temp.(°C)	Digital diagnosis parameter-temperature, in °C, with the precision to 1°C
Voltage(V)	Fault detection parameter-voltage, in V, with the precision to 0.01 V
Bias(mA)	Fault detection parameter-bias current, in mA, with the precision to 0.01 mA
RX power(dBM)	Fault detection parameter-RX power, in dBM, with the precision to 0.01 dBM.
TX power(dBM)	Fault detection parameter-TX power, in dBM, with the precision to 0.01 dBM

Troubleshooting

This chapter describes how to troubleshoot router installation failures.

The router power supply system, fans, and cards have multiple LEDs to help you locate failures.

Configuration terminal problems

If the configuration environment setup is correct, the configuration terminal displays boot information when the router is powered on. If the setup is incorrect, the configuration terminal displays nothing or garbled text.

No terminal display

If the configuration terminal displays nothing when the router is powered on, verify that:

- The power supply system works correctly.
- The MPU works correctly.
- The console cable has been connected to the console port of the MPU.

If no problem is found, the following reasons may apply:

- The console cable is connected to an incorrect serial interface. (The the serial interface in use is not the one set on the terminal.)
- The properties of the terminal are incorrect. You must configure the console terminal as follows: set **Bits per second** to **9600**, **Data bits** to **8**, **Parity** to **None**, **Stop bits** to **1**, **Flow control** to **None**, and **Terminal Emulation** to **VT100**.
- The console cable fails. If the console cable fails, you can replace a cable.

Garbled terminal display

If terminal display is garbled, verify that the following settings are configured for the terminal (for example, HyperTerminal):

- **Baud rate**—9600
- **Data bits**—8
- **Parity**—none
- **Stop bits**—1
- **Flow control**—none
- **Emulation**—VT100

Power supply system failure

The following tables provide LED information for AC and DC power supplies.

Table 19 AC power supply LED

LED	Status	Description
Input	Steady green	Power is being input correctly.
	Off	The power supply is absent or has input voltage error.
Output	Steady green	The power supply is outputting power correctly.
	Off	The power supply has an output voltage error or is absent.
Fault	Steady red	The power supply is experiencing an overvoltage, overcurrent, or over-temperature condition.
	Off	The power module is operating correctly or absent.

Table 20 DC power supply LEDs

LED	Status	Description
IN (input)	Steady green	Power is being correctly input.
	Off	The power supply is absent or has an input voltage error.
OUT (output)	Steady green	The power supply is outputting power correctly.
	Off	The power supply has an output voltage error or is absent.
FAIL (fault)	Steady red	The power supply is experiencing an overvoltage, overcurrent, or over-temperature condition.
	Off	The power supply is operating correctly or absent.

When the input/output LEDs are off or the fault LEDs are on, the power supply does not work properly. To troubleshoot the power supply system:

1. Examine the power cable connections. If a power cable is loose, plug it in.
2. Replace the power cable and verify that the LEDs are normal.
3. Examine the power supply installation. If the power supply is not seated properly, reinstall the power supply so that it makes close contact with the router.
4. Examine the power source. Make sure the power source is operating properly and provides a normal voltage.
5. Determine whether the power supply has encountered output short circuit, output over-current, output over-voltage, input under-voltage, or over-temperature problems.
6. Power off the router, plug the power supply into an empty power supply slot, and verify that the power supply is operating properly. If the power supply is operating properly, the power supply slot may have failed. Otherwise, proceed to the next step.
7. Plug a new power supply of the same model into the same power supply slot and connect it to the same power source. If the new power supply is operating properly, the old power supply fails. Contact the agents to replace the old power supply.

Fan failure

The following tables provide fan LED information.

Table 21 Fan LEDs

LED	Status	Description
RUN	Off	The fan tray has failed.
	Steady green	The fan tray is operating properly.
ALM	Off	The fan tray is in a normal state.
	Steady red	The fan tray is faulty.

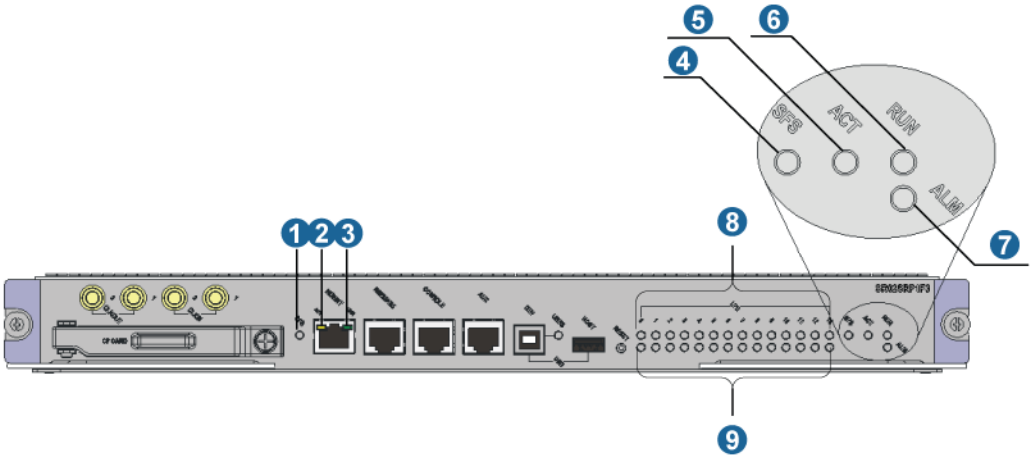
When the RUN LED is off or the ALM LED is on, the fan tray fails. To troubleshoot the fan tray:

1. If both LEDs are off, examine the power supply to make sure it is operating properly. For more information, see "Power supply system failure."
2. Check for blockage of the air intake and exhaust vents on the chassis. If they are blocked, clean them to keep the air flowing.
3. Unplug the fan tray and plug it in again.
4. Plug a spare fan tray into the slot. If the spare fan tray works properly, you can conclude that the old fan tray has failed.
5. If there is still a failure, contact HP Support.

MPU failure

The appearance of routers varies by model. Figure 29 uses SR02SRP1F3 as an example.

Figure 29 MPU LEDs



(1) CF card status LED (CFS)	(2) Network management port LED (ACT)	(3) Network management port LED (LINK)
(4) MPU status LED (SFS)	(5) MPU status LED (ACT)	(6) MPU status LED (RUN)
(7) MPU status LED (ALM)	(8) LPU status LED (RUN)	(9) LPU status LED (ALM)

When the MPU is operating properly, the RUN LED blinks and the ALM LED is off. When the RUN LED is off, the MPU fails. To troubleshoot the MPU:

1. Verify that the power supply is operating properly. For more information, see "Power supply system failure."

2. Press the MPU RESET button to reset the MPU, and then verify that the corresponding RUN LED is on.
3. Make sure the MPU is seated properly. You can unplug the MPU, plug it in again, and make sure the MPU is seated properly.
4. If the router has empty MPU slots, plug the MPU into an empty slot and make sure the MPU is operating properly.
5. If the ALM LED is on, the MPU reports alarms. Use the **display alarm** command to locate and resolve the failures.
6. If there is still a failure, contact HP Support.

LPU failure

When the LPU is operating properly, the RUN LED blinks and the ALM LED is off. At the same time, the RUN LED on the LPU blinks and the ALM LED on the LPU is off.

When the RUN LED is off, the LPU fails. To troubleshoot the LPU:

1. Verify that the MPU is operating properly. For more information, see "MPU failure."
2. Use the **display device** command to determine if the software version is compatible with the LPU in the current slot. If not, upgrade the software to a compatible version.
3. Calculate the overall power consumption and make sure the power supply can provide enough power.
4. Verify that the LPU is seated properly. You can unplug the LPU, plug it in again, and make sure it is seated properly.
5. If the router has empty LPU slots, plug the LPU into an empty slot and make sure the LPU is operating properly.
6. If there is still a failure, contact HP Support.

Interface failure

The MPU and LPU have LINK LEDs that indicate the interface status. When the link of an interface is present and operating properly, the corresponding LINK LED is on.

If the LINK LED of an interface is off, the interface or the connecting cable may fail. To troubleshoot the interface:

1. Make sure the MPU or LPU that provides the interface resides is operating properly. For more information, see "MPU failure" or "LPU failure."
2. Examine the cable connection of the interface. For information on connecting a copper or fiber Ethernet interface, see "Connecting the router to the network."
3. Verify that the cable is not broken. Use the cable to connect two interfaces of the same type that are operating properly. If the LEDs of the two interfaces are on, the cable is normal. Otherwise, the cable fails. Use a compliant cable to connect the interface.
4. If the interface uses a transceiver module, make sure the interface type is compatible with the transceiver module and that the transceiver module is compatible with the cable. For more information, see "Transceiver modules."
5. If the interface uses a transceiver module, replace the module with a normal transceiver module. If the problem persists, you can rule out the transceiver module failure.

6. If the LED is for a copper or fiber combo port, make sure the port has been activated. If not, use the **combo enable** { **copper** | **fiber** } command to activate it. If the LED is still off, the interface or the link has failed.
7. Use the **display interface** command to determine if the interface is UP. If the interface is not UP, use the **undo shutdown** command to bring up the interface.
8. Make sure the speed and duplex settings of the link interfaces are the same, and the interfaces work properly together.
9. If there is still a failure, contact HP Support.

NOTE:

When an interface fails, if the router has an idle interface of the same type, you can plug the cable into the idle interface.

Technical support

If there are still failures, contact HP Support. Before contacting customer service, prepare the following information to help the agents solve the problem as quickly as possible:

- Arrival time of the router
- Serial number of the chassis (located on a label on the rear panel)
- Software version (which you can view by using the **display version** command)
- Maintenance agreement or warranty card
- Brief problem description
- Brief explanation of the troubleshooting measures that have been taken

You can contact customer service through the HP website: http://www.HP.com.

Replacement procedures

This chapter provides information about replacing components on the router.

Replacing a power supply system

⚠ WARNING!

- Power supplies for the router are hot-swappable. When hot-swapping a power supply, make sure the other power supply is operating properly. When installing and replacing a power supply with the router powered on, pay attention to the operation procedures and electricity safety issues. To avoid injury, do not touch any wires, terminals, or parts with a high-voltage hazard sign.
- Hold the power supply by the bottom when moving it. Do not lift the module by the handle.

To prepare for the replacement:

1. Put on an ESD-preventive wrist strap and make sure it makes good skin contact and is well grounded.
2. Make sure the power switch of the DC or AC power supply is in the OFF position before removing it.
3. Remove the cables connected to the DC or AC power supply.

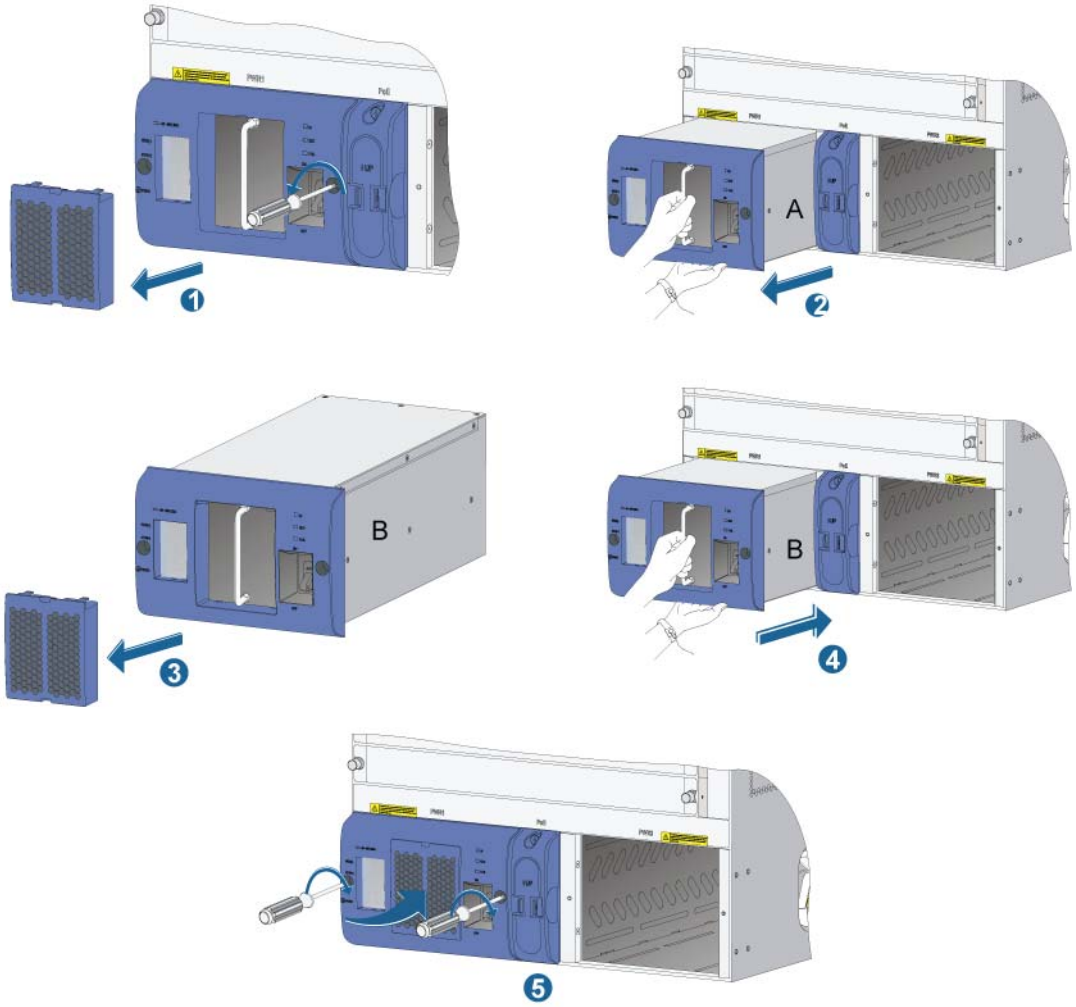
Replacing a DC power supply

1. Use a Phillips screwdriver to loosen the captive screws on both sides of the power supply, remove the air filter frame of the power supply, and pull out the handle of the power supply.
2. Supporting the bottom of the power supply with one hand and holding the power supply handle with the other hand, gently pull the DC power supply out along the slide rails.

   Put the removed power supply on an antistatic mat or its original shipping materials.
3. Remove the air filter frame of the new power supply, and pull out the handle.

   HP recommends that you place a removed module in an antistatic bag or its original shipping materials.
4. Slowly push the new power supply into the slot along the slide rails until the rear side of the power supply has close contact with the backplane.
5. Use a Phillips screwdriver to fasten the captive screws on both sides of the power supply panel, and install the air filter frame of the power supply.

Figure 30 Replacing a DC power supply



(A) DC power supply to be removed	(B) DC power supply to be installed

Replacing an AC power supply

1. Pull the handle of the power supply downward to the unlock position. Gently move the power supply to separate it from the backplane of the power frame.
2. Supporting the bottom of the power supply with one hand and holding the power supply handle with the other hand, gently pull the power supply out.

   Put the removed power supply on an antistatic mat or into the original shipping materials.

NOTE:

If the power frame is installed with two AC power supplies, repeat steps 1 and 2 to remove the other power supply.

3. Use a Phillips screwdriver to loosen the captive screws on both sides of the power frame.
4. Supporting the bottom of the power frame with one hand and holding the power frame handle with the other hand, gently pull the AC power frame out along the slide rails.

   Place a removed power frame in an antistatic bag or its original shipping materials.

5. Slowly push a new power frame into the slot along the slide rails until the rear of the power frame has close contact with the backplane.
6. Use a Phillips screwdriver to fasten the captive screws on both sides of the power frame.
7. Pull the handle of a power supply downward to the unlock position.
8. Gently push the power supply into the specified slot of the AC power frame until the rear of the power supply has close contact with the AC power frame backplane.
9. Push the handle upward so that it locks the power supply in place.

Figure 31 Replacing an AC power frame and an AC power supply

(A) AC power frame to be removed (B) AC power frame to be installed

Cleaning a power supply air filter

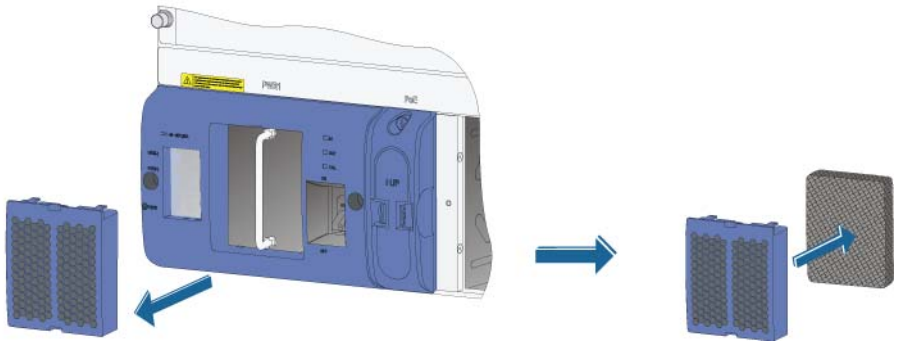
To ensure proper ventilation of the power supply, HP recommends that you clear the air filter monthly.

The NEPS3500-A power frame does not have an air filter.

To clean the power supply air filter:

1. Using your thumb and index finger to hold the upper and lower edges of the air filter frame, gently remove the air filter frame. Pull the black air filter out of the air filter frame.

Figure 32 Removing a power supply air filter

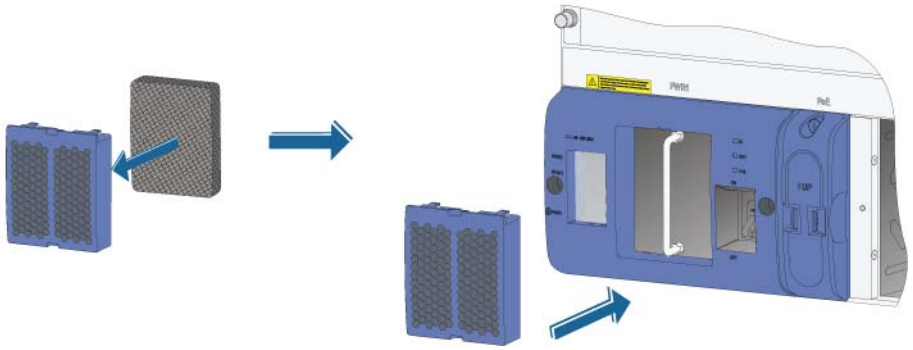


2. Use water to gently wash the air filer, and then air-dry it.

   When you wash the air filter, do not rub it.

3. Put the black air filter into the air filter frame. Using the thumb and index finger to hold the upper and lower edges of the air filter frame, gently insert the air filter frame into the power supply.

Figure 33 Installing a power supply air filter



Replacing a card

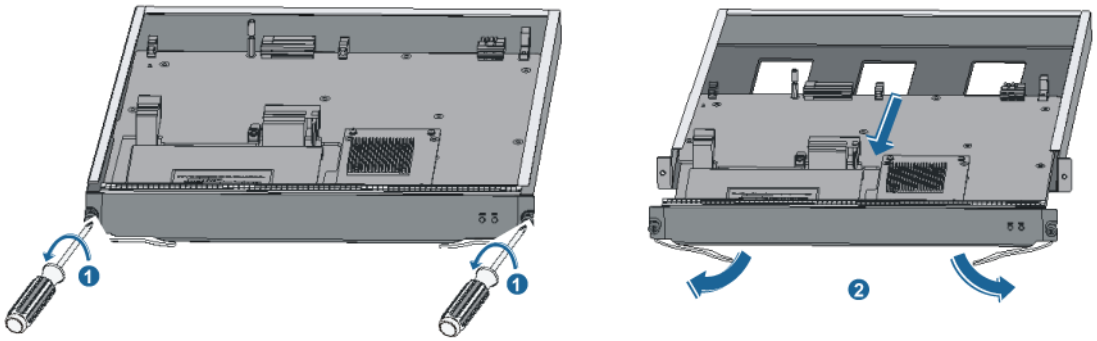
LPUs and MPUs for the router are hot-swappable. Replacement procedures for these types of cards are similar. This section describes how to replace an MPU.

To prepare for the replacement:

1. Put on an ESD-preventive wrist strap and make sure the wrist strap makes good skin contact and is well grounded.

2. Remove the blank panel (if any) from the slot to be used. Keep the removed blank panel and protection cover for future use.
3. Unpack the card to be installed. If the card has a protection cover, remove it. Keep the removed protection cover for future use.

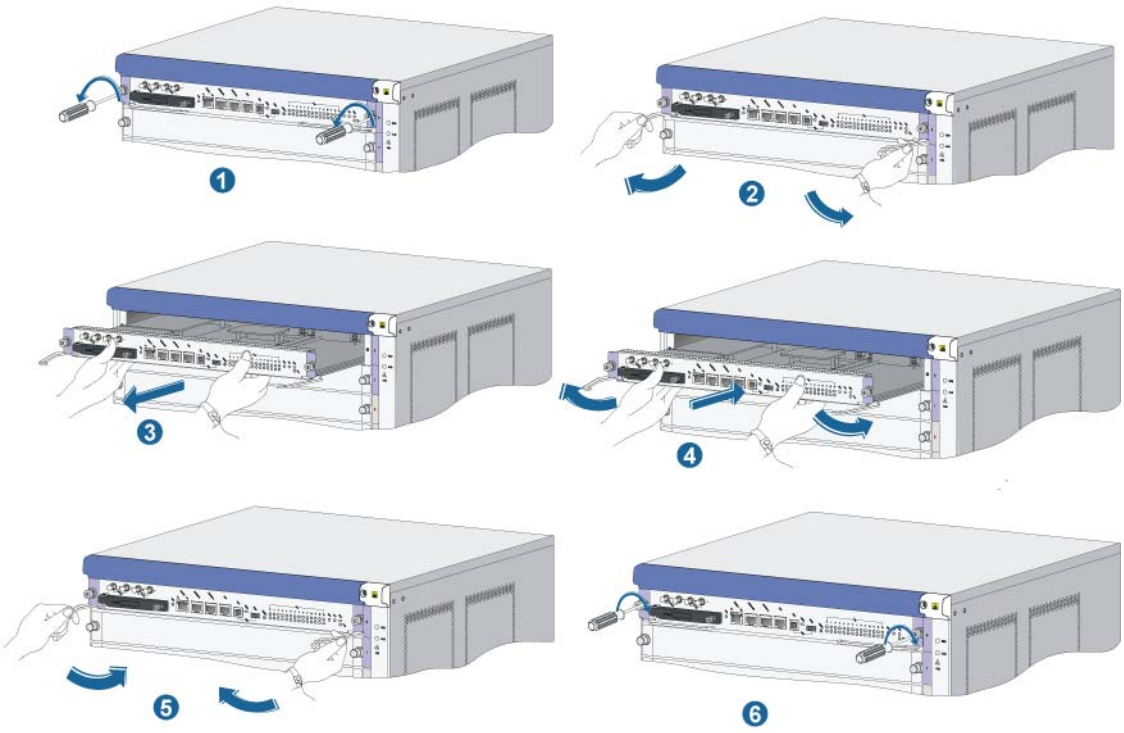
Figure 34 Removing the protection cover



To replace a card:

1. Put on an ESD-preventive wrist strap and loosen the captive screws on both sides of the card to be removed.
2. Pull the ejector levers outward to separate the card from the backplane of the chassis.
3. Slowly pull out the card along the slide rails. Put the removed card on an antistatic mat or into its original shipping materials.
4. Pivot the ejector levers outward. Supporting the card with both hands, gently insert the card into the slot along the slide rails.
5. Push the ejector levers inward to ensure close contact between the card and the backplane.
6. Position the screws in the holes and fasten them with a screwdriver.

Figure 35 Replacing a card



Replacing a subcard

CAUTION:

When the router is operating, you must remove the SPE card before removing or installing the subcard.

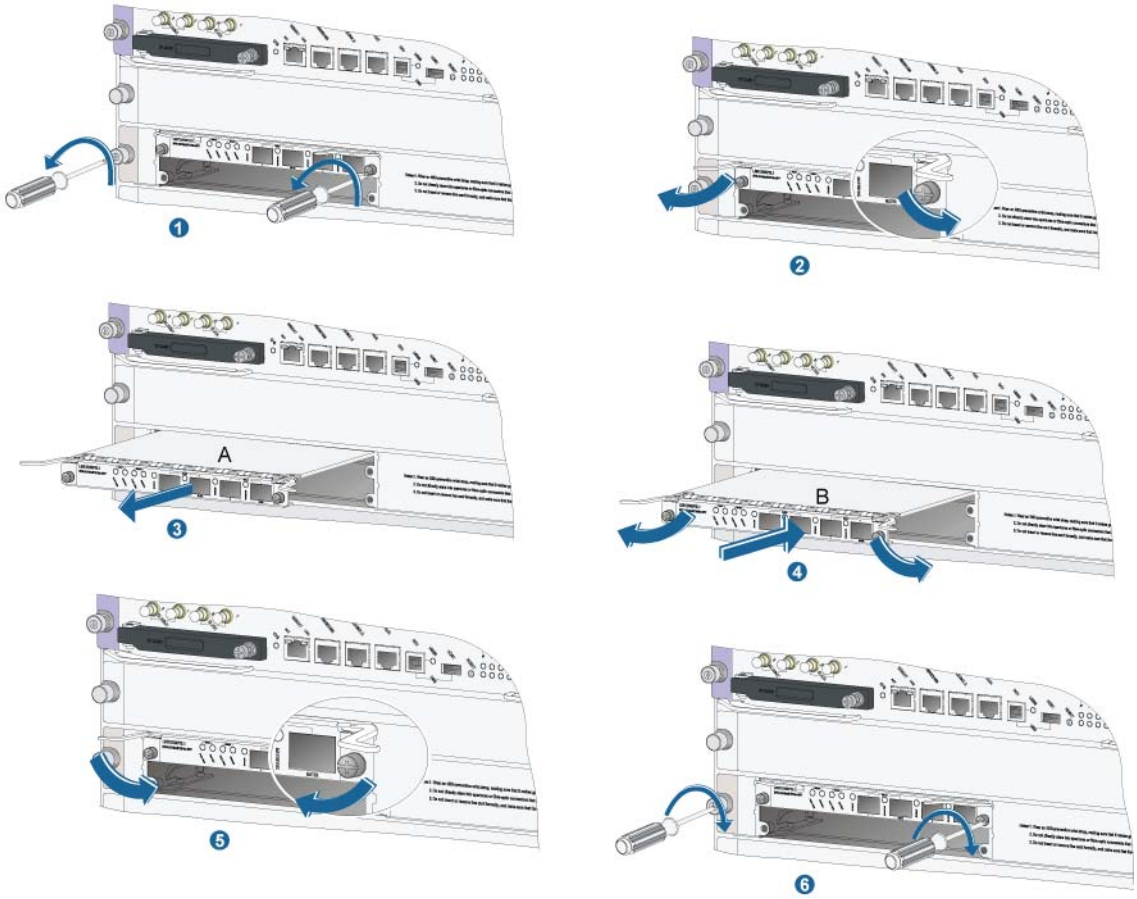
Subcards do not support hot swapping. Replace a subcard using one of the following methods:

- Power off the router, and then remove or install the subcard on the SPE card.
- When the router is operating, remove the SPE card, replace the subcard on the SPE card, and then install the SPE card to the router.

To replace a subcard when the router is powered off:

1. Put on an ESD-preventive wrist strap and loosen the captive screws on the subcard to be replaced.
2. Pull the ejector levers outward to separate the subcard from the SPE card.
3. Slowly pull out the subcard along the guide rails, as shown in Figure 36.
4. Put the removed subcard on an antistatic mat or in the original package.
5. Gently plug the subcard (with the right side up) along the slide rails. When the ejector levers of the subcard reach the panel of the SPE card, stop sliding the subcard. Push the panel of the subcard and move the ejector levers of the subcard inward when the subcard reaches the SPE card, so that the panel of the subcard is on the same plane as the panel of the SPE card.
6. Use a Phillips screwdriver to fasten the captive screws on the subcard to tighten the subcard.

Figure 36 Replacing a subcard



(A) Subcard to be removed	(B) Subcard to be installed

Replacing a fan tray

CAUTION:

Fan trays are hot-swappable. If you replace a fan tray with the router running, pull out the fan tray after it stops rotating and keep your hands away from the spinning fan blades. To avoid injury, do not touch any wires, terminals, or parts with a high-voltage hazard sign.

Replacing a fan tray for an A8805/A8812

The fan trays for the A8805/A8812 routers are installed vertically, and the replacement procedures are the same.

To replace a fan tray for an A8805/A8812:

1. Put on an ESD-preventive wrist strap and loosen the captive screws on the fan tray.
2. Holding the fan tray handle with one hand and supporting the fan tray bottom with the other hand, pull out the fan tray along the slide rails. Put the removed fan tray on an antistatic mat or into its original shipping materials. To ensure normal operation of the router, do not keep the router working without a fan tray for any length of time.

3. Gently insert the new fan tray into the fan tray slot along the slide rails until it has close contact with the backplane.
4. Use a Phillips screwdriver to fasten the captive screws on both sides of the fan tray panel.

Figure 37 Removing a fan tray for an A8805/A8812

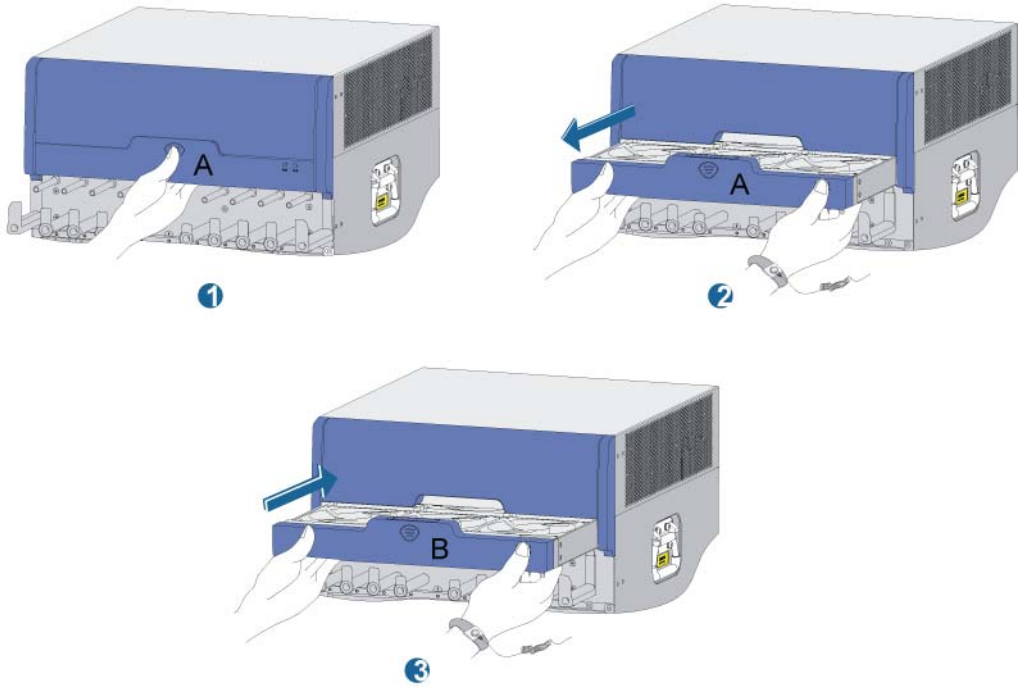
Replacing a fan tray for an A8808

The fan tray for an A8808 is installed horizontally.

To replace a fan tray for an A8808:

1. Use your thumb to press the fan tray button, and then pull the fan tray partway out.
2. Holding both sides of the fan tray, pull out the fan tray along the slide rails. Put the removed fan tray on an antistatic mat or into its original shipping materials.
3. Insert a new fan tray into the fan tray slot along the slide rails until it has close contact with the backplane.

Figure 38 Replacing a fan tray for an A8808



(A) Fan tray to be removed	(B) Fan tray to be installed

Replacing a chassis air filter

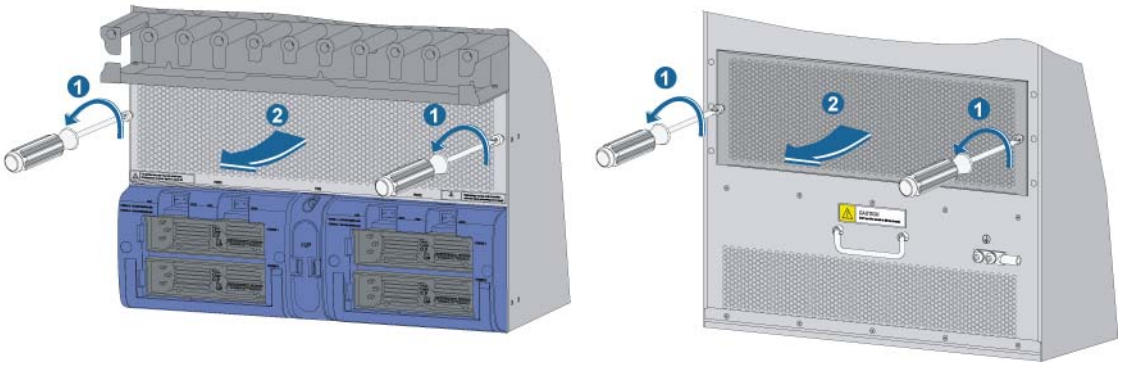
CAUTION:

Clean the air filters every three months to guarantee adequate ventilation and avoid over-temperature. A chassis air filter is not shipped with the router. You can order one if needed.

Replacing chassis air filters for an A8808

1. Use a Phillips screwdriver to remove the captive screws on the front and rear air filters, as shown in Figure 39.
2. Remove the front and rear air filters from the chassis, as shown in Figure 39.
3. Install the cleaned air filters to the router.

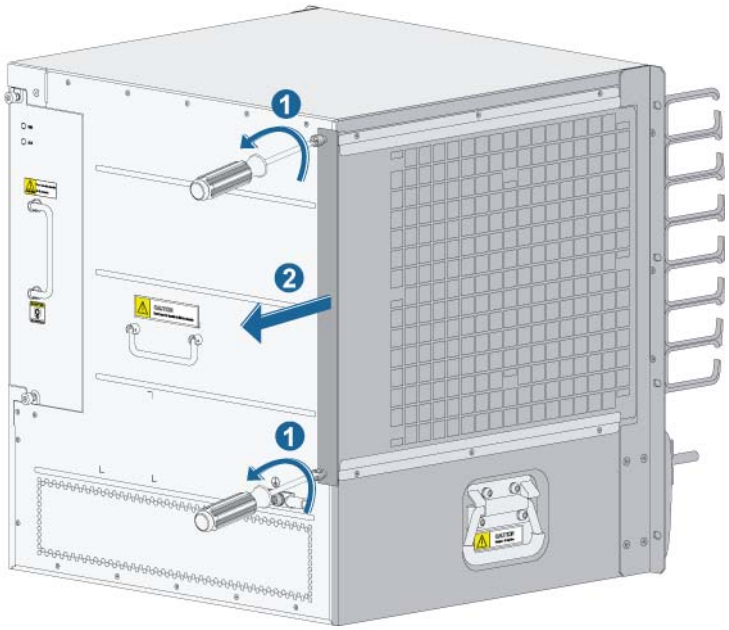
Figure 39 Replacing chassis air filters for an A8808



Replacing an air filter for an A8805/A8812

1. Loosen the captive screws on the air filter, as shown in Figure 40.
2. Grasping the captive screws on the air filter, slowly pull the air filter out of the chassis, as shown in Figure 40.
3. Install the cleaned air filter on the router.

Figure 40 Replacing an air filter for an A8805

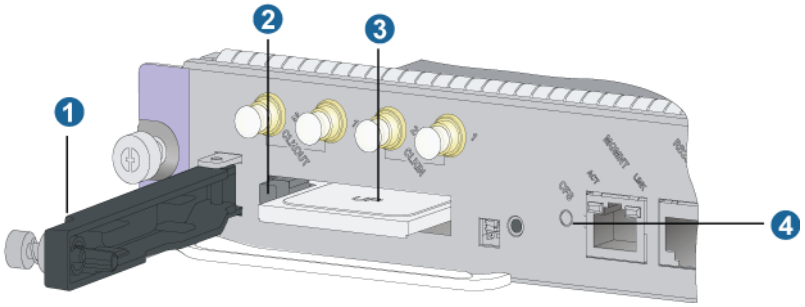


Replacing a CF card

CAUTION:

Do not remove the CF card when the router is booting or the CF card LED is flashing. Otherwise, the file system on the hardware or CF card might be damaged.

Figure 41 CF card slot



(1) CF card cover	(2) CF card eject button
(3) CF card	(4) CF card LED

The CF card is installed on the MPU of the router. If the CF card memory is insufficient or the CF card is damaged, follow these steps to replace the card. Before inserting the CF card, make sure the eject button is all the way into the slot and does not project from the panel.

1. Examine the CF card LED status.
   - If the LED is on, you cannot remove the CF card. You must unmount the CF card using the CLI and wait until the CF card LED is off before removing the CF card.

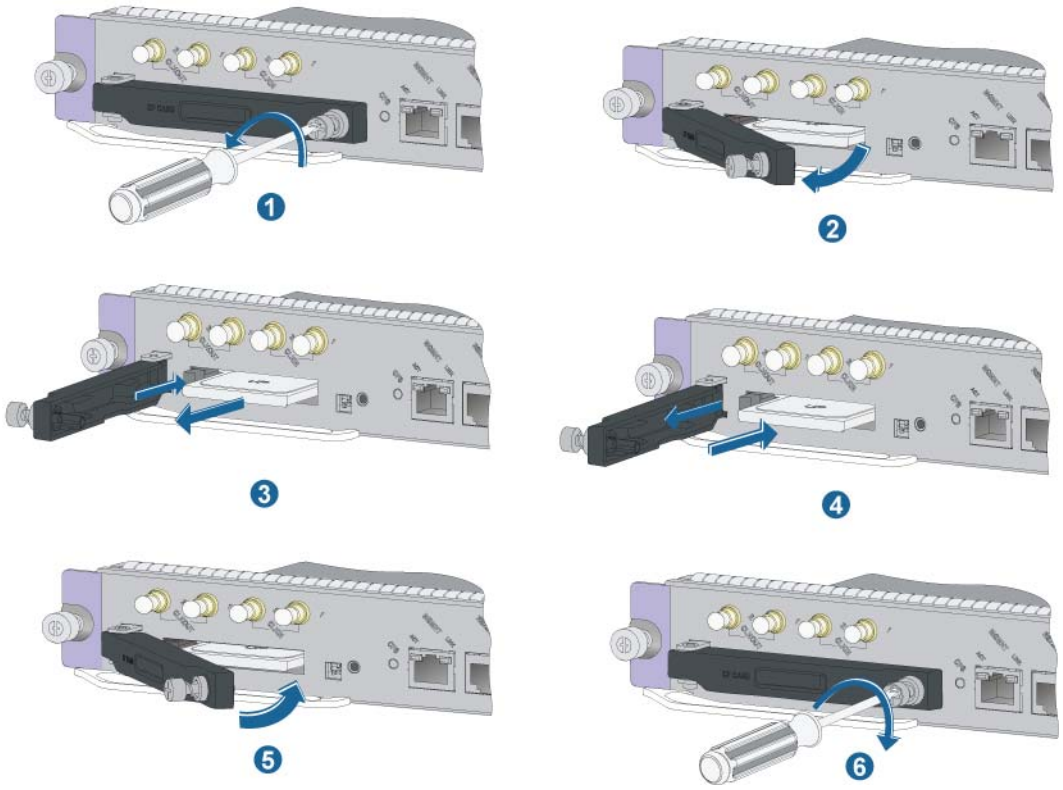
     ```
     <Sysname> umount cfa0:
     ```
   - If the LED is flashing, the CF card is reading and writing data. In this case, you cannot remove the CF card. Wait until the CF card LED stops flashing before removing it.
   - If the LED is off, the CF card has been unmounted and you can remove it.

NOTE:

After you execute the **umount cf** command, if you want to continue to use the CF card, execute the **mount cf** command in user view to load the CF card again. For more information about the **umount** and **mount** commands, see *HP A8800 Routers Fundamentals Command Reference*.

2. Use a Phillips screwdriver to loosen the screw on the right side of the CF card cover, and then pull the CF card cover outward.
3. Press the eject button of the CF card reader. The reader ejects the card partway out of the slot. Remove the CF card from the reader and put it in an antistatic bag or its original shipping materials.
4. Push the new CF card all the way into the CF card slot. The eject button will project out.
5. Push the CF card cover inward.
6. Use a Phillips screwdriver to fasten the screw on the right side of the CF card cover.

Figure 42 Replacing a CF card



Replacing a transceiver module

CAUTION:

When installing or removing an SFP transceiver module, do not touch the golden finger.

The replacement procedures for XFP and SFP transceiver modules are similar. This section uses an SFP transceiver module as an example.

To replace a transceiver module:

1. Put on an ESD-preventive wrist strap, ensuring that the wrist strap makes good skin contact and is grounded.
2. Remove the optical fibers from the SFP transceiver module, pivot the clasp down to the horizontal position, and then pull SFP the transceiver module out of the socket as shown in Figure 43.
3. Put the removed SFP transceiver module in an antistatic bag or its original shipping materials.
4. Unpack a new SFP transceiver module, pivot the clasp of the SFP transceiver module upward to the vertical position so that it catches a knob on the top of the SFP transceiver module, and then, holding both sides of the SFP transceiver module, gently push the SFP transceiver module into the socket until it has close contact with the socket (you can feel that the top and bottom spring tabs catch in the socket), as shown in Figure 44.
5. Connect the optical fibers to the new SFP transceiver module.

Figure 43 Removing an SFP transceiver module

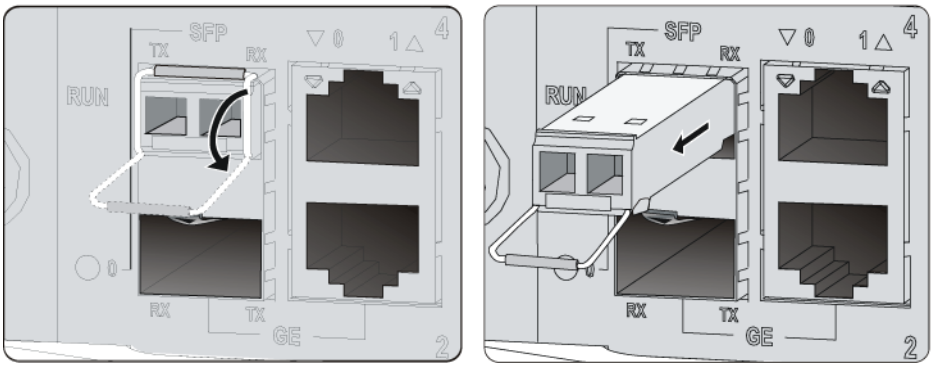
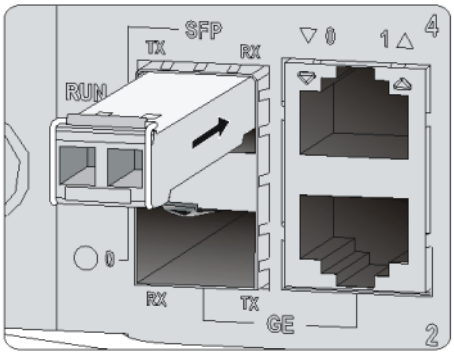


Figure 44 Installing an SFP transceiver module



Hardware specifications

Environmental requirements

Table 22 Environment requirements

Temperature	Range
Operating temperature	Long term: 0°C to 45°C (32°F to 113°F) Short term: –10°C to +55°C (14°F to 131°F) (no more than 96 hours of continuous operation in less than 15 days in one year)
Operating humidity (noncondensing)	5% to 95%
Storage temperature	–40°C to +70°C (–40°F to +158°F)
Operating altitude	Available altitude: ≤ 4000 m (13123.36 ft) Certificated altitude: ≤ 3000 m (9842.52 ft)

Technical specifications

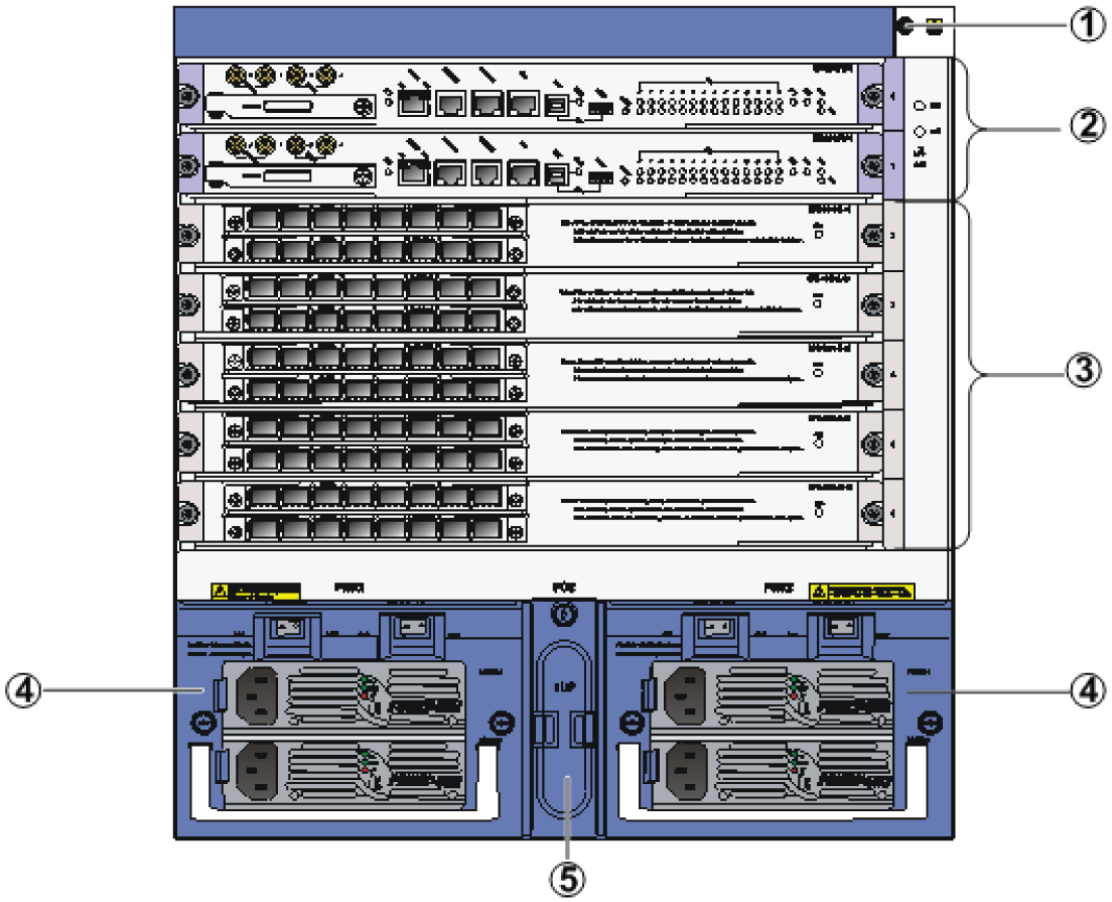
The diagrams in this document are for illustration only. AC-powered chassis are used as an example.

Chassis

A8805 chassis views

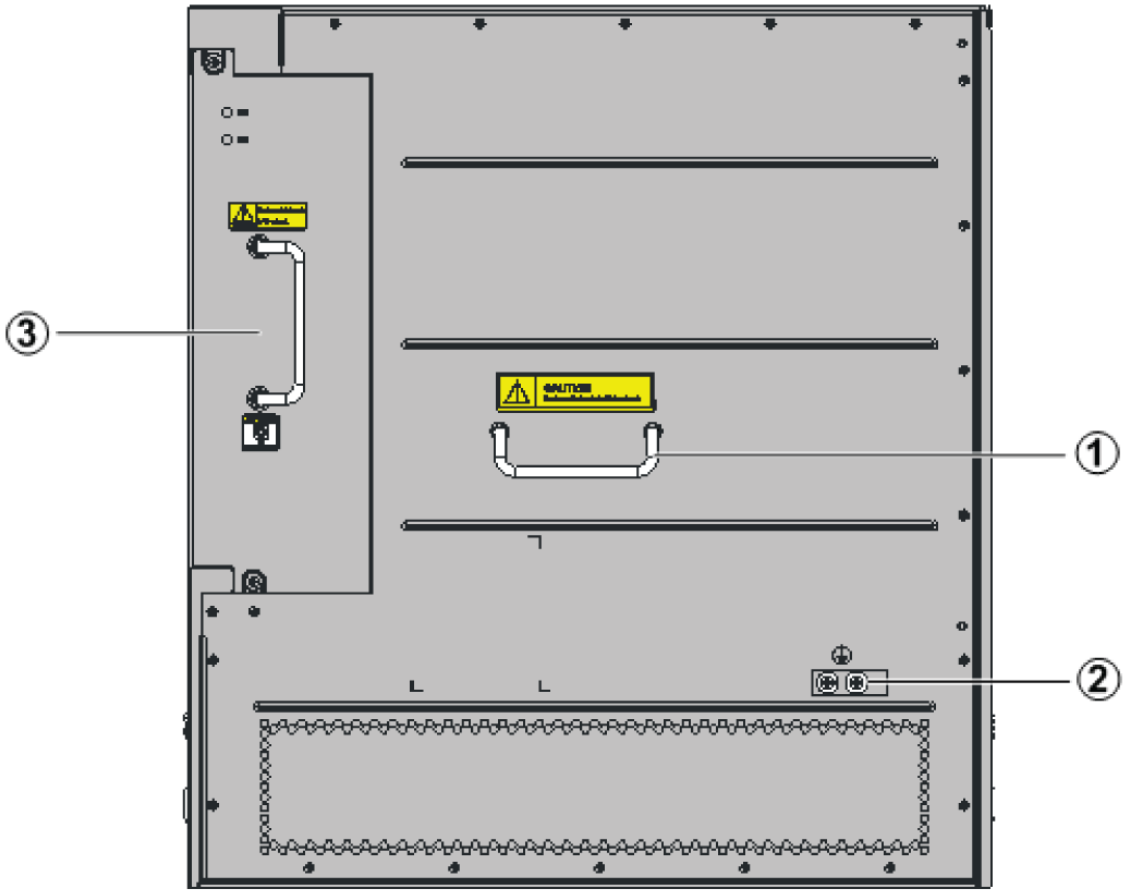
You can install one or two power supplies, but you cannot mix AC and DC power supplies. Figure 45 shows the A8805 with four AC power supplies installed in the two AC power frames.

Figure 45 A8805 front view



(1) ESD-preventive wrist strap port	(2) MPU slots (slots 0 and 1)	(3) LPU slots (slots 2 to 6)
(4) Power supply slots	(5) PoE power entry module (reserved)	

Figure 46 A8805 rear view

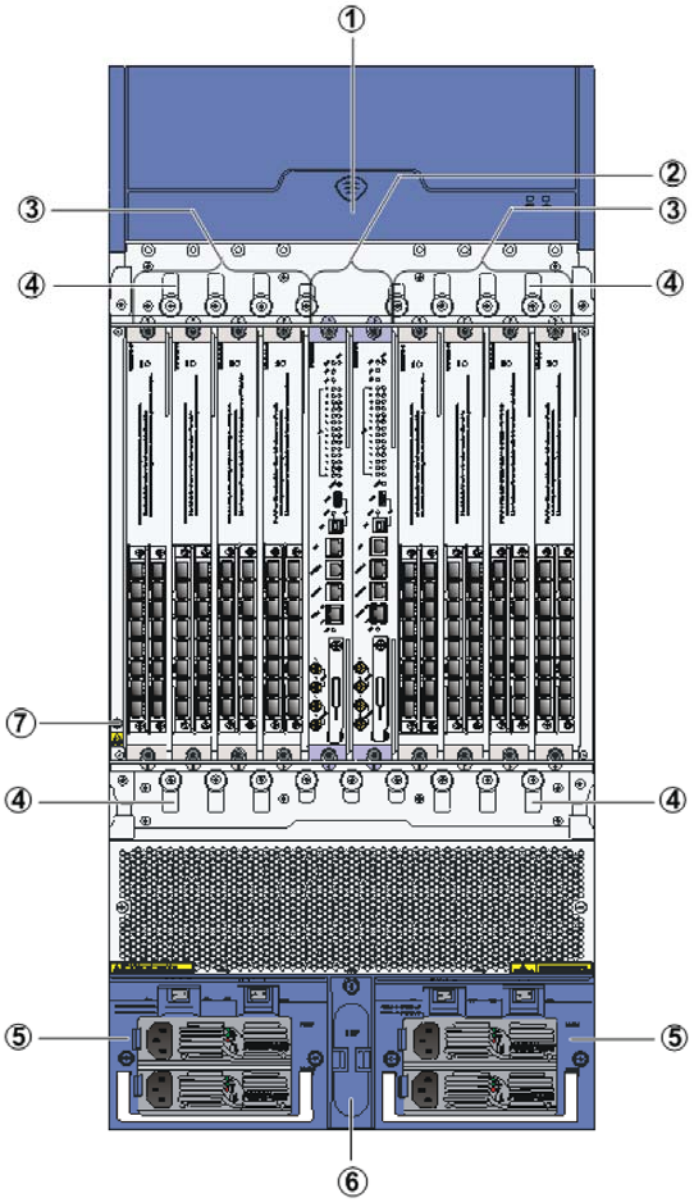


(1) Rear cover handle	(2) Grounding screw	(3) Fan tray

A8808 chassis views

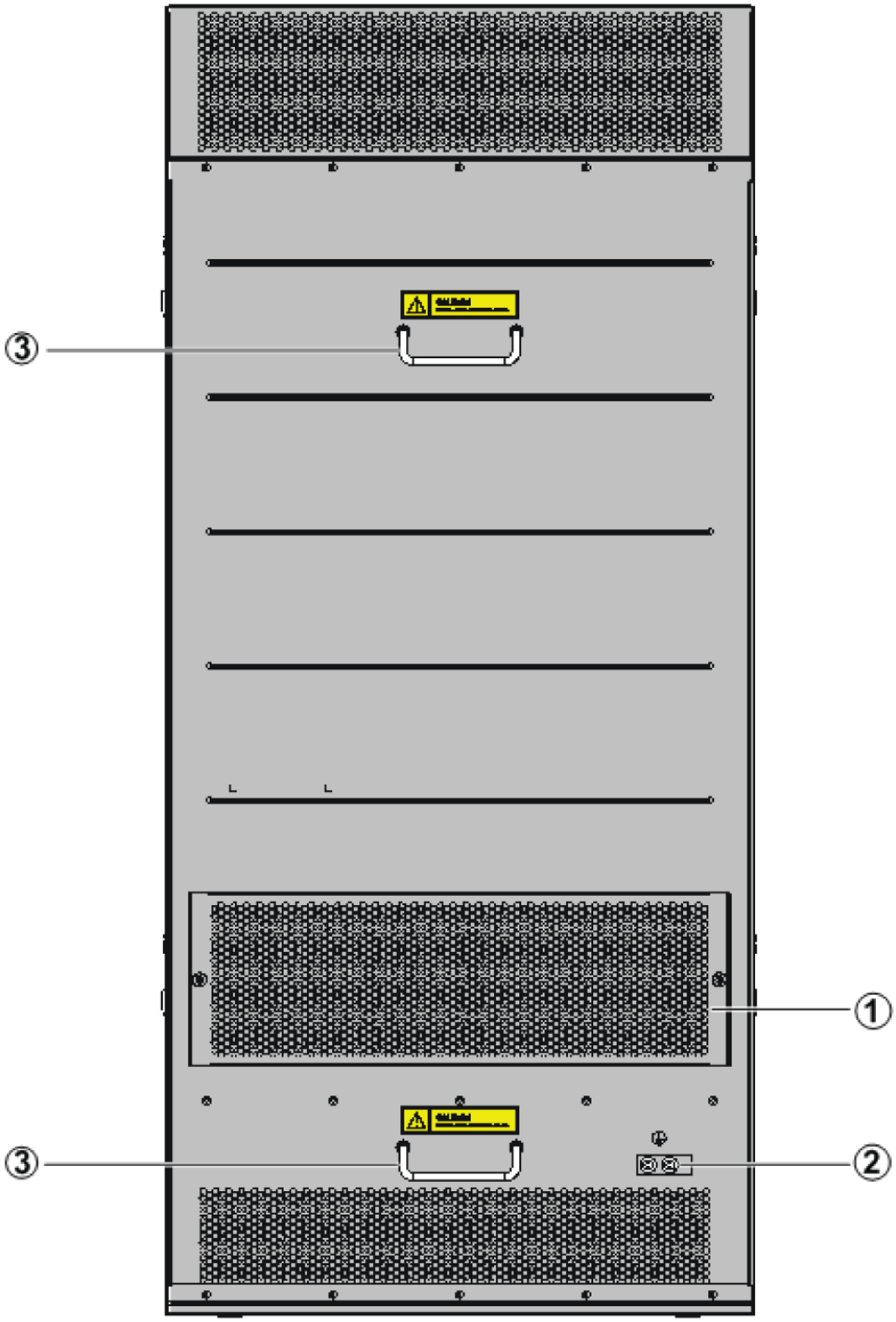
You can install one or two power supplies, but do not intermix AC and DC power supplies. In this figure, four AC power supplies are installed in the two AC power frames.

Figure 47 A8808 front view



(1) Fan tray	(2) MPU slots (slots 4 and 5)	(3) LPU slots (slots 0 to 3, 6 to 9)
(4) Cable management bracket	(5) Power supply slots	(6) PoE power entry module (reserved, currently not available)
(7) ESD-preventive wrist strap port		

Figure 48 A8808 rear view

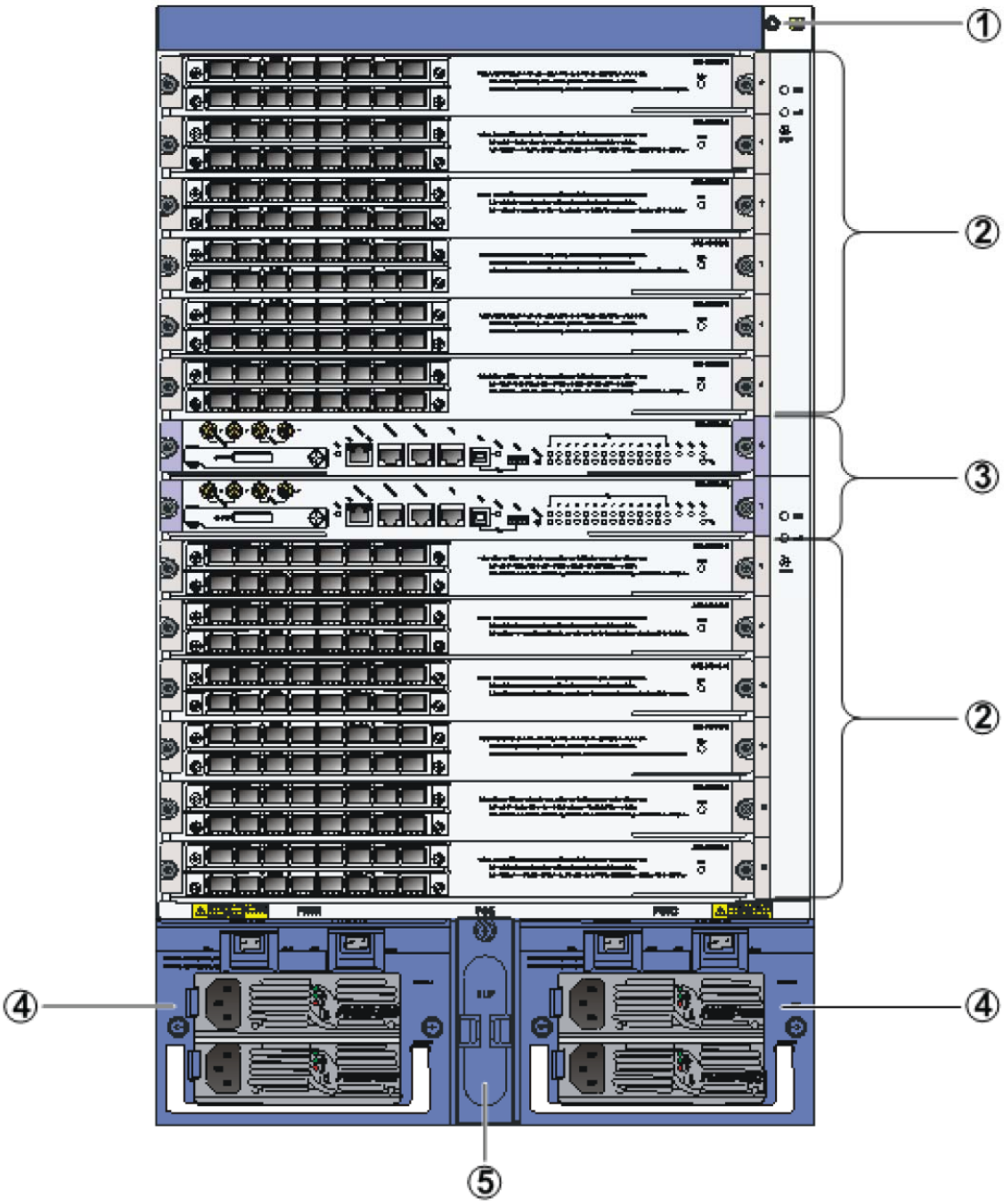


(1) Air filter	(2) Grounding screw	(3) Rear cover handle

A8812 chassis views

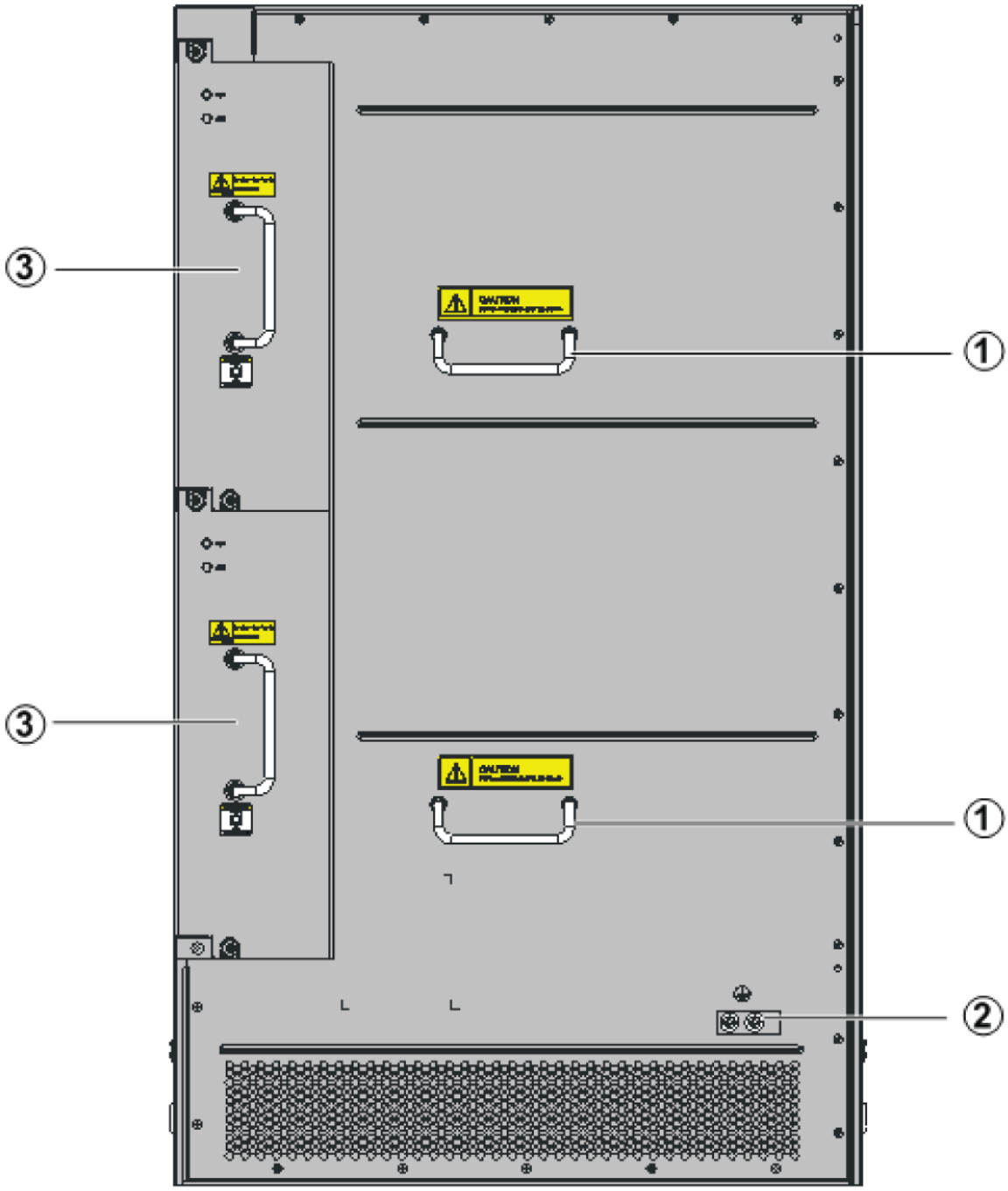
You can install one or two power supplies, but intermixing of AC and DC power supplies is not allowed. In this figure, four AC power supplies are installed in the two AC power frames.

Figure 49 A8812 front view



(1) ESD-preventive strap port	(2) LPU slots (slots 0 to 5, 8 to 13)	(3) MPU slots (slots 6 and 7)
(4) Power supply slots	(5) PoE power entry module (reserved, currently not available)	

Figure 50 A8812 rear view



(1) Rear cover handle	(2) Grounding screw	(3) Fan tray

Chassis specifications

Table 23 Chassis specifications

Model	Max power consumption	Weight	Dimensions (H × W × D)	Height (RU)
A8805	2040 W (AC) 1795 W (DC)	Net weight: 40 kg (88.18 lb) Full configuration: ≤ 85 kg (187.39 lb)	486 × 442 × 450 mm (19.13 × 17.40 × 17.72 in)	11 RU
A8808	2916 W (AC) 2671 W (DC)	Net weight: 58 kg (127.87 lb) Full configuration: ≤ 110 kg (242.50 lb)	975 × 436 × 450 mm (38.39 × 17.17 × 17.72 in)	22 RU
A8812	4248 W (AC) 4003 W (DC)	Net weight: 60 kg (132.28 lb) Full configuration: ≤ 120 kg (264.55 lb)	753 × 442 × 450 mm (29.65 × 17.40 × 17.72 in)	17 RU

NOTE:

RU is a unit of measure that describes the height of a device mounted in a rack. 1 RU equals 44.45 mm (1.75 in).

Cooling system

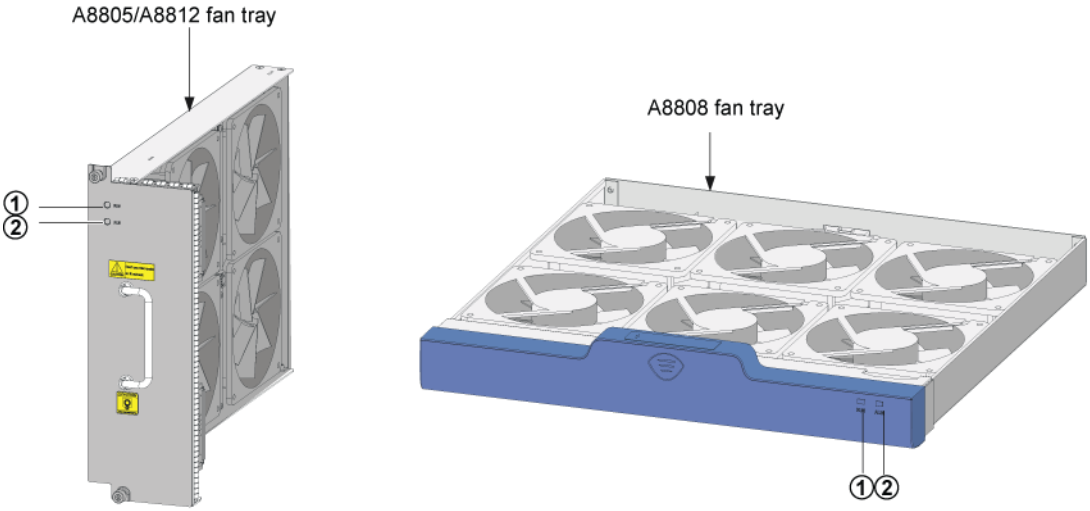
Fan trays

The router uses fan trays for heat dissipation. The fan trays are hot-swappable. You can replace fan trays without powering off the router. The fan trays can monitor the operating status of fans, automatically adjust fan rotation speed to decrease noise and improve energy efficiency, and display alarms.

IMPORTANT:

The A8805 and the A8812 routers use the same type of fan trays, but the A8808 router uses a different type of fan tray.

Figure 51 Fan trays



(1) RUN LED	(2) ALM LED

Table 24 Fan LEDs

LED	Status	Description
RUN	Off	The fan tray has failed.
	Steady green	The fan tray is working correctly.
ALM	Off	The fan tray is in a normal state.
	Steady red	The fan tray is faulty.

Table 25 Fan tray specifications

Fan tray	Power consumption	Net weight	Dimensions (H × W × D)
Fan tray for A8805/A8812	12 W to 90 W	3.97 kg (8.75 lb)	299.5 × 95 × 412.7 mm (11.79 × 3.74 × 16.25 in)
Fan tray for A8808	16 W to 130 W	4.85 kg (10.69 lb)	64 × 403.2 × 405.4 mm (2.52 × 15.87 × 15.96 in)

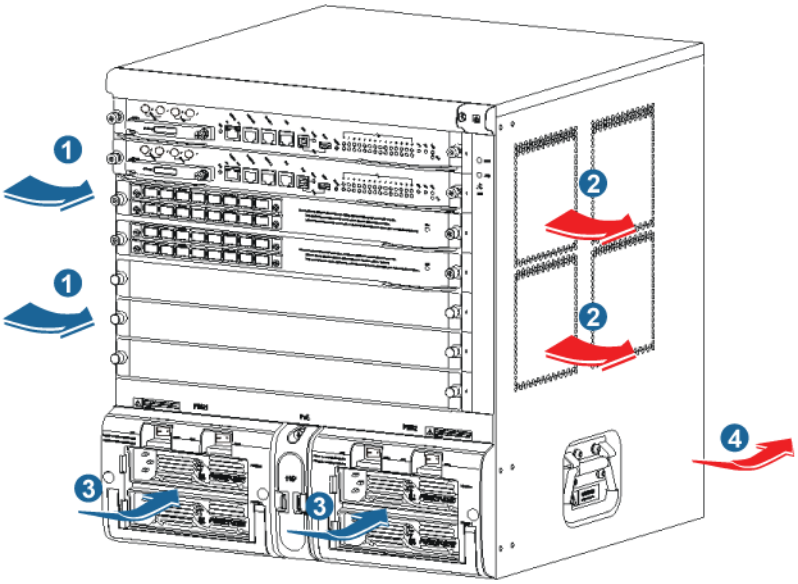
NOTE:

The A8805/A8812 uses a vertical fan tray slot; the A8808 adopts the horizontal fan tray slot.

A8805 and A8812 airflow

The chassis and power supplies for the A8805 and A8812 use separate air aisles. The airflow for the power supply section at the bottom is from front to rear; the airflow for the chassis is from left to right, as shown in Figure 52.

Figure 52 A8805 airflow

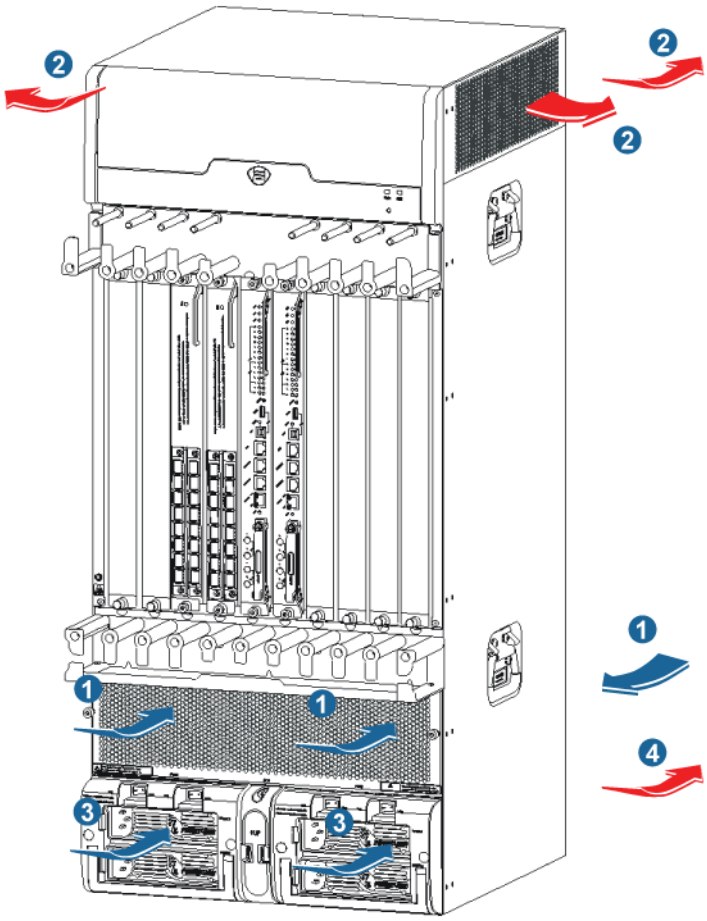


(1) Chassis air intake	(2) Chassis air outlet	(3) Power supply air intake	(4) Power supply air outlet

A8808 airflow

The chassis and power supplies for the A8808 use separate air aisles. For the power supply section at the bottom, air flows from front to rear; for the chassis, air flows in through the air intake vents at the lower rear and front of the chassis, and exhausts out the side air outlets and rear air outlets at the top of the chassis, as shown in Figure 53.

Figure 53 A8808 airflow



(1) Chassis air intake (2) Chassis air outlet (3) Power supply air intake (4) Power supply air outlet

If you have installed a rear impedance carrier for the A8808, the fan tray cannot pull ambient air in from the rear but can still blow hot air out the rear.

Card specifications

Table 26 Card specifications

Card model	Power consumption	Net weight	Dimensions (H × W × D)
SR02SRP1F3	52 W to 65 W	3.20 kg (7.05 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SR02SRP2F3	79 W to 95 W	3.50 kg (7.72 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPC-XP2L	50 W to 60 W	3.10 kg (6.83 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPC-XP4L	82 W to 95 W	3.30 kg (7.28 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)

Card model	Power consumption	Net weight	Dimensions (H × W × D)
SPC-GP48L	67 W to 115 W	3.50 kg (7.72 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPC-GP24L	47 W to 75 W	5.00 kg (11.02 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPC-GT48L	72 W to 125 W	3.60 kg (7.94 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPE-1010	80 W to 95 W	4.00 kg (8.82 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPE-1010-II	80 W to 95 W	3.60 kg (7.94 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPE-1020	148 W to 165 W	3.90 kg (8.60 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPE-1020-II	148 W to 165 W	4.40 kg (9.70 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPE-1010-E	94 W to 107 W	3.60 kg (7.94 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPE-1020-E	160 W to 200 W	4.50 kg (9.92 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
SPE-1010-E-II	94 W to 107 W	3.60 kg (7.94 lb)	40 × 400 × 380 mm (1.57 ×15.75 × 14.96 in)
SPE-1020-E-II	160 W to 200 W	4.50 kg (9.92 lb)	40 × 400 × 380 mm (1.57 ×15.75 × 14.96 in)
PIC-GP10L	9.27 W to 21 W	0.45 kg (0.99 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-GP20R	15.69 W to 25 W	0.70 kg (1.54 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
PIC-GT20R	16.32 W to 23.5 W	0.65 kg (1.43 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
PIC-XP1L	12.47 W to 23.7 W	0.45 kg (0.99 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-RSP2L	16.79 W to 25 W	0.40 kg (0.88 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-RUP1L	14.3 W to 19 W	0.50 kg (1.10 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-PSP4L	9.7 W to 18	0.40 kg (0.88 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-PUP1L	14.3 W to 19 W	0.50 kg (1.10 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-PS2G4L	9.23 W to 16 W	0.40 kg (0.88 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-PL2G6L	9.7 W to 18 W	0.40 kg (0.88 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-PH2G6L	9.7 W to 17 W	0.40 kg (0.88 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-TCP8L	9.7 W to 17 W	0.40 kg (0.88 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-ALP4L	30 W to 37 W	0.60 kg (1.32 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
PIC-AHP1L	29.7 W to 36 W	0.60 kg (1.32 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
PIC-CSP1L	9.6 W to 16 W	0.40 kg (0.88 lb)	18 × 165 × 142 mm (0.71 × 6.50 × 5.59 in)
PIC-CL1G8L	18.13 W to 32 W	0.60 kg (1.32 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)

Card model	Power consumption	Net weight	Dimensions (H × W × D)
PIC-CL2G8L	18.22 W to 33 W	0.65 kg (1.43 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
PIC-CLS4G4L	30.86 W to 37 W	0.65 kg (1.43 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
PIC-CHS1G4L	24 W to 30 W	0.60 kg (1.32 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
PIC-ET8G8L	22.91 W to 28.4 W	0.60 kg (1.32 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
PIC-ET32G2L	18 W to 22 W	1.25 kg (2.76 lb)	37 × 165 × 142 mm (1.46 × 6.50 × 5.59 in)
IM-NAT	94 W to 107 W	2.90 kg (6.39 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
IM-NAT-II	94 W to 107 W	3.40 kg (7.50 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
IM-NAM	94 W to 107 W	3.40 kg (7.50 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
IM-FW-II	84.88 W to 120 W	3.52 kg (7.76 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
IM-SSL	91.82 W to 110 W	3.52 kg (7.76 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
IM-LB	84.88 W to 120 W	3.52 kg (7.76 lb)	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)
IM-NAM-II	94 W to 107 W	3.40 kg (7.50 lb)	40 × 400 × 380 mm (1.57 ×15.75 × 14.96 in)

For more information about the router card LEDs, see "LEDs." For more information about the router cards, see the appropriate card datasheet.

MPU specifications

CAUTION:

The USB ports on the MPU can be used only to connect to storage media such as USB disk, and cannot be used to charge external equipment. Otherwise, the MPU might fail.

Table 27 MPU specifications

Item	SR02SRP1F3	SR02SRP2F3
SDRAM	2 GB by default (expandable to 4 GB)	
CF card	1 GB by default	
Dimensions (H × W × D), including the handle	40 × 400 × 380 mm (1.57 × 15.75 × 14.96 in)	
Applicable routers	A8805/A8808/A8812	

Item	SR02SRP1F3	SR02SRP2F3
Ports	• 1 console port • 1 AUX port • 1 network management port • 1 RS-232/485 port (reversed for future use) • 1 CF card slot • 2 SMB coaxial Stratum-3 clock output interfaces • 2 SMB coaxial Stratum-3 clock input interfaces • 2 USB ports (the secondary USB port is not supported)	

SPC card specifications

Table 28 SPC card specifications

Model	Interface type and number	Supported interface modules
SPC-XP2L	2-port 10GBASE-R/W optical Ethernet interface card (XFP, LC)	10-GE XFP module
SPC-XP4L	4-port 10GBASE-R/W optical Ethernet interface card (XFP, LC)	10-GE XFP module
SPC-GP48L	48-port 1000BASE-X optical Ethernet interface card (SFP, LC)	GE SFP module
SPC-GP24L	24-port 1000BASE-X optical Ethernet interface card (SFP, LC)	GE SFP module
SPC-GT48L	48-port 10/100/1000BASE-T electrical Ethernet interface card (RJ-45)	N/A

SPE card specifications

Table 29 SPE card specifications

Model	Number of slots	Description
SPE-1010	1	Single Processor Service Engine Module
SPE-1010-II	1	Single Processor Service Engine Module
SPE-1020	2	Dual Processor Service Engine Module
SPE-1020-II	2	Dual Processor Service Engine Module
SPE-1010-E	1	Enhanced Single Service Processing Engine Module
SPE-1020-E	2	Enhanced Dual Service Processing Engine Module
SPE-1010-E-II	1	Enhanced Single Processor Service Engine Module
SPE-1020-E-II	2	Enhanced Dual Processor Service Engine Module

Subcard specifications

Table 30 Subcard specifications

Model	Interface type and number	Available transceiver modules and cables
PIC-GP10L	10-port 1000BASE-X optical Ethernet interface card (SFP, LC)	• FE SFP module • GE SFP module
PIC-GP20R	20-port 1000BASE-X optical Ethernet interface card (SFP, LC)	• FE SFP module • GE SFP module
PIC-GT20R	20-port 10/100/1000BASE-T electrical Ethernet interface card (RJ-45)	N/A
PIC-XP1L	1-port 10GBASE-R/W optical Ethernet interface card (XFP, LC)	10-GE XFP module
PIC-RSP2L	2-port OC-48c/STM-16c RPR optical interface card (SFP, LC)	OC-48/STM-16 SFP module
PIC-RUP1L	1-port OC-192c/STM-64c RPR optical interface card (XFP, LC)	10-GE XFP module
PIC-PSP4L	4-port OC-48c/STM-16c POS optical interface card (SFP, LC)	• FE SFP module • GE SFP module
PIC-PUP1L	1-port OC-192c/STM-64c POS optical interface card (XFP, LC)	10-GE XFP module
PIC-PS2G4L	2-port OC-48c/STM-16c POS optical interface (SFP, LC) + 4-port 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • OC-48/STM-16 SFP module
PIC-TCP8L	8-port OC-3c/STM-1c, OC-12c/STM-4c POS, or 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • OC-3/STM-1 SFP module • OC-12/STM-4 SFP module
PIC-ALP4L	4-port OC-3c/STM-1c ATM optical interface card (SFP, LC)	OC-3/STM-1 SFP module
PIC-AHP1L	1-port OC-12c/STM-4c ATM optical interface card (SFP, LC)	OC-12/STM-4 SFP module
PIC-PL2G6L	2-port OC-3c/STM-1c POS optical interface (SFP, LC) + 6-port 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • OC-3/STM-1 SFP module
PIC-PH2G6L	2-port OC-12c/STM-4c POS optical interface (SFP, LC) + 6-port 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • OC-12/STM-4 SFP module
PIC-CSP1L	1-port OC-48/STM-16 channelized to OC-48c/STM-16c, OC-12c/STM-4c, or OC-3/STM-1c CPOS optical interface card (SFP, LC)	OC-48/STM-16 SFP module

Model	Interface type and number	Available transceiver modules and cables
PIC-CL1G8L	1-port OC-3/STM-1 channelized to E1/T1 CPOS optical interface (SFP, LC) + 8-port 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • OC-3/STM-1 SFP module
PIC-CL2G8L	2-port OC-3/STM-1 channelized to E1/T1 CPOS optical interface (SFP, LC) + 8-port 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • OC-3/STM-1 SFP module
PIC-CLS4G4L	4-port OC-3/STM-1 channelized to OC-3c/STM-1c POS or E3/T3 CPOS optical interface (SFP, LC) + 4-port 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • OC-3/STM-1 SFP module
PIC-CHS1G4L	1-port OC-12/STM-4 channelized to OC-12c/STM-4c or E3/T3 CPOS optical interface (SFP, LC) + 4-port 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • OC-12/STM-4 SFP module
PIC-ET8G8L	8-port CE1/CT1 electrical interface (RJ-45) + 8-port 1000BASE-X optical interface card (SFP, LC)	• FE SFP module • GE SFP module • E1/T1 cable
PIC-ET32G2L	32-port CE1/CT1 electrical interface (2 DB-28 female connectors) + 2-port 1000BASE-X optical interface card (SFP, LC)	• GE SFP module • E1/T1 cable

OAA module specifications

CAUTION:

Upgrade OAA module software though console ports or Ethernet ports on the OAA modules, rather than the MPU.

Table 31 OAA module specifications

Model	Interfaces	Supported interface modules
IM-FW-II	• One console port • One CF card slot, supporting a 256 MB/512 MB/1 GB CF card • Two USB ports (reserved) • Two 10/100/1000 BASE-T copper ports • Two GE combo interfaces	GE SFP modules
IM-SSL	• One console port • One CF card slot, supporting a 256 MB/512 MB/1 GB CF card • Two USB ports (reserved)	GE SFP modules

Model	Interfaces	Supported interface modules
IM-LB	• One console port • Two USB ports (reserved) • Two 10/100/1000 BASE-T copper ports • Two GE combo interfaces	GE SFP modules

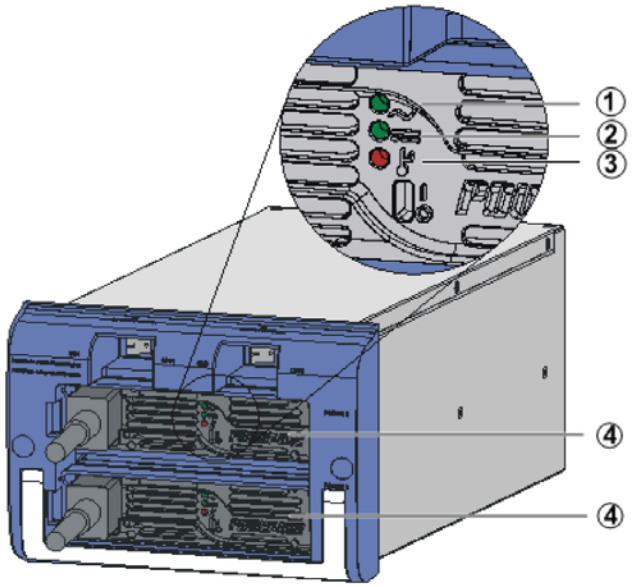
Power supply system

Table 32 lists the power supplies available for the router. These power supplies are hot-swappable. For the power supply weights, see Table 35. For the power supply electrical specifications, see Table 36.

Table 32 Power supply compatibility matrix

Power supply	A8805	A8808	A8812
NEPS1800-A	Yes	Yes	Yes
NEPS2000-D	Yes	Yes	Yes
NEPS3500-D	No	Yes	Yes

Figure 54 NEPS3500-A power frame



(1) Power input LED (2) Power output LED (3) Power fault LED (4) Power supplies (NEPS1800-A)

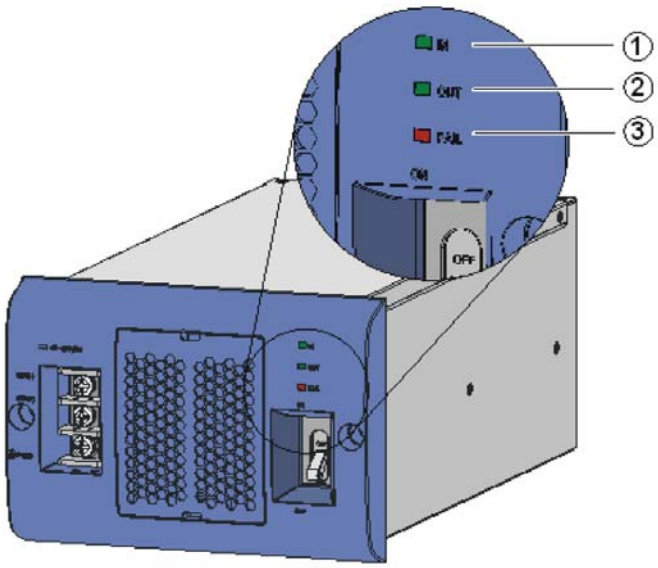
NOTE:

You can install one or two NEPS1800-A AC power modules into the NEPS3500-A power frame. If two NEPS1800-A power modules are installed, the maximum output power is 3500 W.

Table 33 AC power supply LEDs

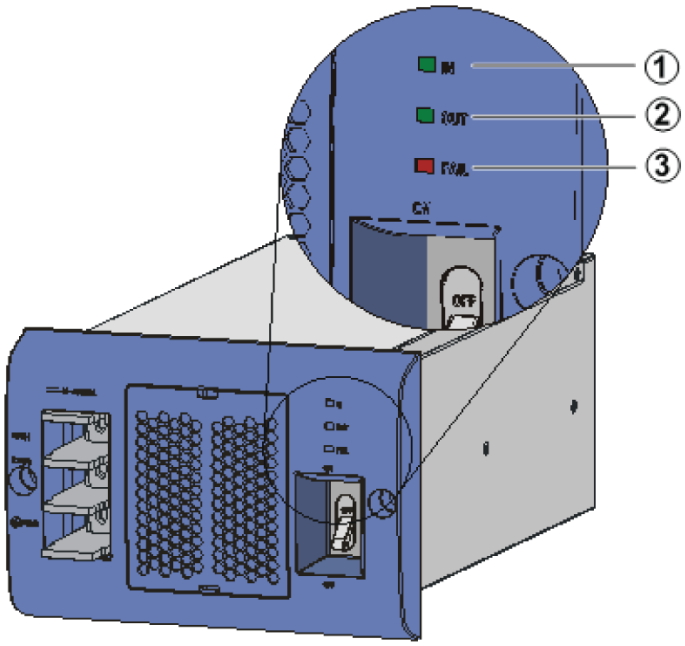
LED	Status	Description
Input (IN)	Steady green	The input voltage is in the normal range.
	Off	The power supply or power supply is absent or has an input voltage error.
Output (OUT)	Steady green	The power supply or power supply is outputting power correctly.
	Off	The power supply or power supply is absent or has an output voltage error.
Fault (FAIL)	Steady red	The power supply or power supply is experiencing an overvoltage, overcurrent, or over-temperature condition.
	Off	The power supply or power supply is operating correctly or absent.

Figure 55 NEPS2000-D DC power supply



(1) Power input LED (2) Power output LED (3) Power fault LED

Figure 56 NEPS3500-D DC power supply



(1) Power input LED	(2) Power output LED	(3) Power fault LED

Table 34 DC power supply LEDs

LED	Status	Description
IN (input)	Steady green	Power is being input correctly.
	Off	The power supply is absent or has an input voltage error.
OUT (output)	Steady green	The power supply is outputting power correctly.
	Off	The power supply has an output voltage error or is absent.
FAIL (fault)	Steady red	The power supply is experiencing an overvoltage, overcurrent, or over-temperature condition.
	Off	The power supply is operating correctly or absent.

Table 35 Power supply weights

Model	Description	Max output power	Net weight
NEPS3500-A	3500 W AC power frame	3500 W (when two power supplies are installed)	3.90 kg (8.60 lb) (excluding power supplies)
NEPS1800-A	1800 W AC power supply	1200 W (100 VAC to 120 VAC) 1800 W (200 VAC to 240 VAC)	2.25 kg (4.96 lb)
NEPS2000-D	2000 W DC power supply	2000 W	6.36 kg (14.02 lb)
NEPS3500-D	3500 W DC power supply	3500 W	6.14 kg (13.54 lb)

Select AC or DC power supplies according to the power supply mode of your router.

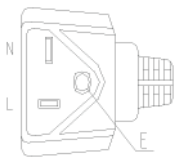
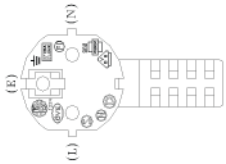
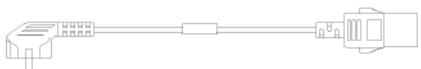
- Make sure the maximum total output power of the power supplies exceeds the system power consumption. (HP recommends reserving a certain power de-rating value.) For the maximum output power of a single power supply, see Table 36.
- HP recommends that you configure N+1 or N+M power supply redundancy.
- To use the AC power supply, select the 16 A AC power cables. For the 16A AC power cables used in different countries or regions, see Table 37.
- The NEPS3500-A AC power frame functions properly only if you install one or two NEPS1800-A AC power supplies.

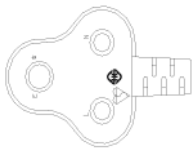
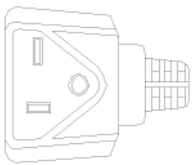
Table 36 Power supply electrical specifications

Model	Description	Rated input voltage range	Max input voltage range	Max input current	Max output power
NEPS3500-A	3500 W AC power frame	100 VAC to 240 VAC; 50 Hz or 60 Hz	90 VAC to 264 VAC; 50 Hz or 60 Hz	2×16A	3500 W (when installed with two AC power supplies)
NEPS1800-A	1800 W AC power supply	100 VAC to 240 VAC; 50 Hz or 60 Hz	90 VAC to 264 VAC; 50 Hz or 60 Hz	16 A @ 110 VDC 12 A @220 VDC	1200 W (100 VAC to 120 VAC) 1800 W (200 VAC to 240 VAC)
NEPS2000-D	2000 W DC power supply	–60 VDC to –48 VDC	–75 VDC to –36 VDC	45 A @ –48 VDC	2000 W
NEPS3500-D	3500 W DC power supply	–60 VDC to –48 VDC	–75 VDC to –36 VDC	80 A @ –48 VDC	3500 W

Table 37 16 A AC power cables for countries or regions

No.	Specifications				
1	Connector type	Code (Length)	Countries or regions where the type of power cables conforms to local safety regulations and can be used legally	Other countries or regions using this type of power cables	Countries or regions seldom using this type of power cables
	I type	04043396 (3 m or 9.8 ft)	Mainland China		
	Connector outline		Power cable outline		Connector outline

No.	Specifications				
2	Connector type	Code (Length)	Countries or regions where the type of power cables conforms to local safety regulations and can be used legally	Other countries or regions using this type of power cables	Countries or regions seldom using this type of power cables
	B type	0404A063 (3 m or 9.8 ft)	Canada and U.S.	Mexico, Argentina, Brazil, Columbia, Venezuela, Thailand, Peru, Philippines	
	Connector outline		Power cable outline		Connector outline
					
3	Connector type	Code (Length)	Countries or regions where the type of power cables conforms to local safety regulations and can be used legally	Other countries or regions using this type of power cables	Countries or regions seldom using this type of power cables
	F type	0404A061 (3 m or 9.8 ft)	Holland, Denmark, Sweden, Finland, Norway, Germany, France, Austria, Belgium, and Italy	Indonesia, Turkey, Russia, and CIS	
	Connector outline		Power cable outline		Connector outline
					

No.	Specifications				
4	Connector type	Code (Length)	Countries or regions where the type of power cables conforms to local safety regulations and can be used legally	Other countries or regions using this type of power cables	Countries or regions seldom using this type of power cables
	G type	0404A060 (3 m or 9.8 ft)	U.K.	Malaysia, Singapore, Hong Kong, and Egypt	
	Connector outline		Power cable outline		Connector outline
					
5	Connector type	Code (Length)	Countries or regions where the type of power cables conforms to local safety regulations and can be used legally	Other countries or regions using this type of power cables	Countries or regions seldom using this type of power cables
	B type	0404A062 (3 m or 9.8 ft)	Japan		
	Connector outline		Power cable outline		Connector outline
					
6	Connector type	Code (Length)	Countries or regions where the type of power cables conforms to local safety regulations and can be used legally	Other countries or regions using this type of power cables	Countries or regions seldom using this type of power cables

No.	Specifications				
	I type	0404A01A (3 m or 9.8 ft)	Australia		
	Connector outline		Power cable outline		Connector outline
	Connector type	Code (Length)	Countries or regions where the type of power cables conforms to local safety regulations and can be used legally	Other countries or regions using this type of power cables	Countries or regions seldom using this type of power cables
7	C19	0404A0C2 (3 m/9.8 ft)	Mainland China		
	Connector outline		Power cable outline		Connector outline

LEDs

In this document, SPC cards refer to the interface cards prefixed with SPC, for example, SPC-GP48L, and SPE cards refer to the base cards prefixed with SPE, for example, SPE-1020-E.

Power supply LEDs

Table 38 AC power supply LEDs

LED	Status	Description
Input	Steady green	Power is being input correctly.
	Off	The power supply is absent or has an input voltage error.
Output	Steady green	The power supply is outputting power correctly.
	Off	The power supply has an output voltage error or is absent.
Fault	Steady red	The power supply is experiencing an overvoltage, overcurrent, or over-temperature condition.
	Off	The power supply is operating correctly or absent.

Table 39 DC power supply LEDs

LED	Status	Description
IN (input)	Steady green	Power is being input correctly.
	Off	The power supply is absent or has an input voltage error.
OUT (output)	Steady green	The power supply is outputting power correctly.
	Off	The power supply has an output voltage error or is absent.
FAIL (fault)	Steady red	The power supply is experiencing an overvoltage, overcurrent, or over-temperature condition.
	Off	The power supply is operating correctly or absent.

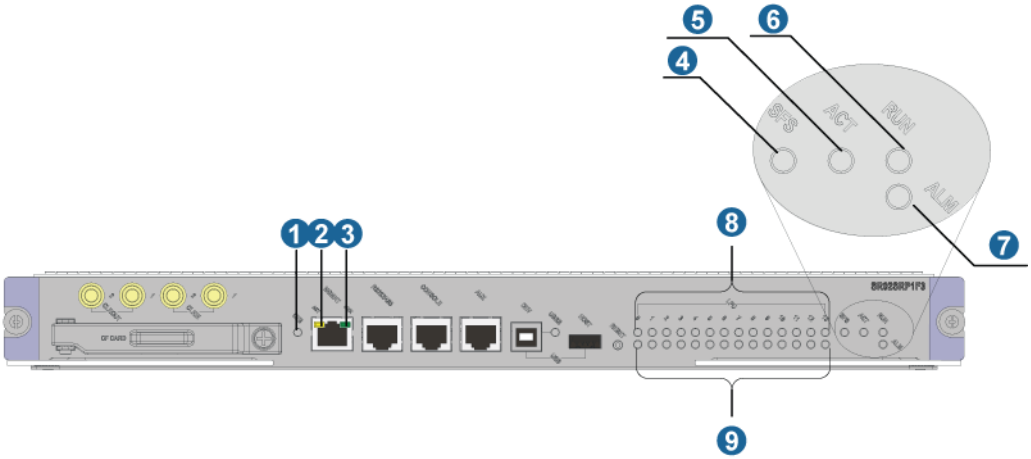
Fan LEDs

Table 40 Fan LEDs

LED	Status	Description
RUN	Off	The fan tray has failed.
	Steady green	The fan tray is operating correctly.
ALM	Off	The fan tray is in a normal state.
	Steady red	The fan tray is faulty.

MPU LEDs

Figure 57 MPU LEDs



(1) CF card status LED (CFS)	(2) Network management port LED (ACT)	(3) Network management port LED (LINK)
(4) MPU status LED (SFS)	(5) MPU status LED (ACT)	(6) MPU status LED (RUN)
(7) MPU status LED (ALM)	(8) LPU status LED (RUN)	(9) LPU status LED (ALM)

The appearance of A8800 MPUs varies by MPU model. Figure 57 takes SR02SRP1F3 for illustration.

CF card status LED

Table 41 CF card status LEDs

LED	Status	Description
CFS (green)	Steady on	The CF card is in position and idle.
	Flashing	The CF card is in position and performing read/write operations. Do not unplug it.
	Off	The CF card is out of position or offline. You can plug it in or unplug it.

NOTE:

When the CF card LED is on, do not unplug it. Before unplugging the card, execute the **umount** command in user view to uninstall the CF card, and then unplug the CF card when the LED is off.

Network management port LEDs

Table 42 Network management port LEDs

LED	Status	Description
LINK	Off	No link is present.
	Steady green	A link is present.
ACT	Off	No data is being transmitted or received.

LED	Status	Description
	Flashing yellow	Data is being transmitted and/or received.

LPU status LEDs

Table 43 LPU status LEDs

LED	Status	Description
RUN	Steady green	The LPU is faulty.
	Off	The LPU is faulty or is not in position.
	Flashing green (8 times per second)	The LPU is registering or starting up.
	Flashing green (1 time per second)	The LPU is operating correctly.
ALM	Steady red	An alarm occurs.
	Off	No alarm occurs.

MPU status LEDs

The MPU status LEDs vary by MPU model. Table 44 lists the LEDs for the SR02SRP1F3/SR02SRP2F3 MPU.

Table 44 MPU status LEDs

LED	Status	Description
SFS	Steady green	The switching fabric module is in the working state or is starting up.
	Off	The switching fabric module is in the standby state.
ACT	Steady green	The MPU is in the active state.
	Off	The MPU is in the standby state.
RUN	Flashing green (8 times per second)	The MPU is in the registration state or is starting up.
	Flashing green (1 time per second)	The MPU is operating correctly.
	Steady green	The MPU is faulty.
	Off	The MPU is faulty or is not in position.
ALM	Steady red	An alarm occurs.
	Off	No alarm occurs.

SPC card LEDs

The SPC card LEDs vary by card model.

LINK/ACT LED

Table 45 describes the LINK/ACT LED for the interfaces on the SPC-GP48L card and the GE fiber interfaces numbered from 1 to 16 on the SPC-GP24L card.

Table 45 Interface LED

LED	Status	Description
LINK/ACT	Steady green	The interface is connected.
	Off	The interface is not connected correctly.
	Flashing green	Data is being transmitted and/or received on the interface.

Combo interface LED

The SPC-GP24L provides combo interfaces, each having one copper port and one fiber port. Each copper or fiber combo port has a LED. On the SPC-GP24L, the fiber combo ports are numbered from 17 to 24, and the copper combo ports are numbered from 25 to 32. For the LED description, see Table 46.

Table 46 Combo interface LED

LED	Color	Status	Description
LINK/ACT (yellow-green)	yellow	Steady on	The combo port is activated. By default, the copper combo port is activated.
		Off	The combo port is not activated.
	Green	Steady on	A link is present.
		Off	No link is present.
		Flashing	The port is transmitting or receiving data.

LINK and ACT LEDs

Each interface on the following SPC cards has a LINK LED and an ACT LED:

- SPC-XP2L
- SPC-XP4L

Table 47 Interface LEDs

LED	Status	Description
LINK	Off	No link is present.
	Steady green	A link is present.
ACT	Off	No data is being transmitted or received.
	Flashing yellow	Data is being transmitted and/or received.

SPE card LED

The LED for all SPE cards is the same.

Table 48 SPE card LED

LED	Status	Description
RUN	Steady green	The card is faulty or is starting up.
	Off	The card is faulty or is not in position.
	Flashing green (1 time per second)	The card is operating correctly.
	Fast flashing green (8 times per second)	The LED flashes fast when the card is starting up. If the LED keeps flashing fast, the card was not registered successfully.

Subcard LEDs

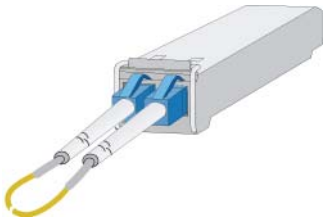
For information about the subcard LEDs, see the subcard manuals.

Transceiver modules

CAUTION:

If you connect a long-haul (at least 40 km, or 24.86 miles) transceiver module to a short optical fiber (see Figure 58) for loopback test, use an optical attenuator to decrease optical power and avoid the transceiver module being damaged by high optical power.

Figure 58 Loopback operation on a transceiver module



10-GE XFP transceiver modules

Table 49 10-GE XFP transceiver module specifications

Product code	Description	Central wavelength	Connector	Fiber	Max. transmission distance
JD117B	HP X130 10G XFP LC SR Transceiver	850 nm	LC	62.5/125 μm multi-mode optical fiber	See Table 50.
		850 nm	LC	50/125 μm multi-mode optical fiber	
JD108B	HP X130 10G XFP SC LR Transceiver	1310 nm	LC	9/125 μm single-mode optical fiber	10 km (6.21 miles)
JD121A	HP X135 10G XFP LC ER Transceiver	1550 nm	LC	9/125 μm single-mode optical fiber	40 km (24.86 miles)
JD107A	HP X130 10G XFP SC ZR Transceiver	1550 nm	LC	9/125 μm single-mode optical fiber	80 km (49.71 miles)

Table 50 Maximum transmission distance of 10-GE multi-mode optical fibers

Fiber type	Modal bandwidth (MHz*km)	Max. transmission distance
62.5/125 μm multi-mode optical fiber	160	26 m (85.30 ft)
62.5/125 μm multi-mode optical fiber	(OM1) 200	33 m (108.27 ft)
50/125 μm multi-mode optical fiber	400	66 m (216.54 ft)
50/125 μm multi-mode optical fiber	(OM2) 500	82 m (269.03 ft)
50/125 μm multi-mode optical fiber	(OM3) 2000	300 m (984.25 ft)

NOTE:

Multi-mode optical fibers are described using a system of classification determined by the ISO 11801 standard—OM1, OM2, and OM3—which is based on the modal bandwidth of the multi-mode optical fiber.

FE/GE SFP transceiver modules

Table 51 FE/GE SFP transceiver modules specifications

Product code	Description	Central wavelength	Connector	Fiber	Max. transmission distance
JD118B	HP X120 1G SFP LC SX Transceiver	850 nm	LC	50/125 μm multimode optical fiber	550 m (1804.46 ft)
		850 nm	LC	62.5/125 μm multimode optical fiber	275 m (902.23 ft)
JD119B	HP X120 1G SFP LC LX Transceiver	1310 nm	LC	9/125 μm single mode optical fiber	10 km (6.21 miles)
JD061A	HP X125 1G SFP LC LH40 1310nm Transceiver	1310 nm	LC	9/125 μm single mode optical fiber	40 km (24.86 miles)
JD062A	HP X120 1G SFP LC LH40 1550nm Transceiver	1550 nm	LC	9/125 μm single mode optical fiber	40 km (24.86 miles)
JD063B	HP X125 1G SFP LC LH70 Transceiver	1550 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)
JD103A	HP X120 1G SFP LC LH100 Transceiver	1550 nm	LC	9/125 μm single mode optical fiber	100 km (62.14 miles)
JD098B	HP X120 1G SFP LC BX 10-U Transceiver	1490 nm (Rx)/1310 nm (Tx)	LC	9/125 μm single mode optical fiber	10 km (6.21 miles)
JD099B	HP X120 1G SFP LC BX 10-D Transceiver	1310 nm (Rx) /1490 nm (Tx)	LC	9/125 μm single mode optical fiber	10 km (6.21 miles)
JD113A	HP X170 1G SFP LC LH70 1470 Transceiver	1470 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)
JD114A	HP X170 1G SFP LC LH70 1490 Transceiver	1490 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)

Product code	Description	Central wavelength	Connector	Fiber	Max. transmission distance
JD115A	HP X170 1G SFP LC LH70 1510 Transceiver	1510 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)
JD116A	HP X170 1G SFP LC LH70 1530 Transceiver	1530 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)
JD109A	HP X170 1G SFP LC LH70 1550 Transceiver	1550 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)
JD110A	HP X170 1G SFP LC LH70 1570 Transceiver	1570 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)
JD111A	HP X170 1G SFP LC LH70 1590 Transceiver	1590 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)
JD112A	HP X170 1G SFP LC LH70 1610 Transceiver	1610 nm	LC	9/125 μm single mode optical fiber	70 km (43.50 miles)
JF833A	HP X110 100M SFP LC FX Transceiver	1310 nm	LC	50/125 μm multimode optical fiber	2 km (1.24 miles)
		1310 nm	LC	62.5/125 μm multimode optical fiber	2 km (1.24 miles)
JF832A	HP X120 100M/1G SFP LC LX Transceiver	1310 nm	LC	9/125 μm single mode optical fiber	10 km (6.21 miles)
JD089B	HP X120 1G SFP RJ45 T Transceiver	N/A	RJ-45	Category 5 or higher twisted pair	100 m (328.08 ft)

NOTE:

- The JD098B and JD099B must be used in pairs.
- The JF833A is installed in a 1000-Mbps fiber port, but it provides only the port speed of 100 Mbps.
- The JF832A is installed in a 1000-Mbps fiber port, and it provides the port speed of 100 Mbps or 1000 Mbps.
- The interface card PIC-ET32G2L does not support 100-Mbps transceiver modules, including the JF833A and the 100-Mbps JF832A.

OC-48/STM-16 SFP transceiver modules

Table 52 OC-48/STM-16 SFP transceiver modules

Product code	Description	Central wavelength	Connector	Fiber	Max. transmission distance
JD084A	HP X160 2.5G SFP LC 2km Transceiver	1310 nm	LC	9/125 μm single-mode optical fiber	2 km (1.24 miles)
JD085A	HP X160 2.5G SFP LC 15km Transceiver	1310 nm	LC	9/125 μm single-mode optical fiber	15 km (9.32 miles)
JD086A	HP X160 2.5G SFP LC 40km Transceiver	1310 nm	LC	9/125 μm single-mode optical fiber	40 km (24.86 miles)
JD087A	HP X160 2.5G SFP LC 80km Transceiver	1550 nm	LC	9/125 μm single-mode optical fiber	80 km (49.71 miles)

OC-12/STM-4 SFP transceiver modules

Table 53 OC-12/STM-4 SFP transceiver modules

Product code	Description	Central wavelength	Connector	Fiber	Max transmission distance
JF829A	HP X120 622M SFP LC LX 15km Transceiver	1310 nm	LC	9/125 μm single-mode optical fiber	15 km (9.32 miles)
JF830A	HP X120 622M SFP LC LH 40km 1310 Transceiver	1310 nm	LC	9/125 μm single-mode optical fiber	40 km (24.86 miles)
JF831A	HP X120 622M SFP LC LH 80km 1550 Transceiver	1550 nm	LC	9/125 μm single-mode optical fiber	80 km (49.71 miles)

OC-3/STM-1 SFP transceiver modules

Table 54 OC-3/STM-1 SFP transceiver modules

Product code	Description	Central wavelength	Connector	Fiber	Max transmission distance
JD102B	HP X110 100M SFP LC FX Transceiver	1310 nm	LC	50/125 μm multimode optical fiber	2 km (1.24 miles)
		1310 nm	LC	62.5/125 μm multimode optical fiber	2 km (1.24 miles)

Product code	Description	Central wavelength	Connector	Fiber	Max transmission distance
JD120B	HP X110 100M SFP LC LX Transceiver	1310 nm	LC	9/125 μm single-mode optical fiber	15 km (9.32 miles)
JD090A	HP X110 100M SFP LC LH40 Transceiver	1310 nm	LC	9/125 μm single-mode optical fiber	40 km (24.86 miles)
JD091A	HP X110 100M SFP LC LH80 Transceiver	1550 nm	LC	9/125 μm single-mode optical fiber	80 km (49.71 miles)

Lightning protection

Connecting the AC power supply to a power strip with lightning protection

If part of the AC power line is routed outdoors, use a power strip with lightning protection to connect the AC power cable of the router to the AC power line to protect the router from being damaged by lightning strikes.

You can attach the power strip to the rack, workbench, or wall of equipment room.

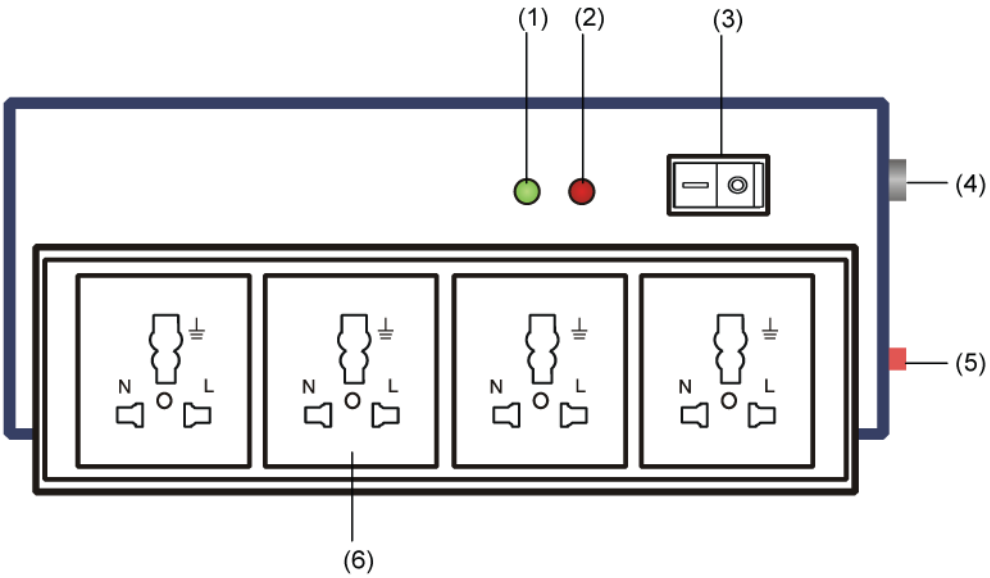
After you connect the AC power cable from the router to a socket on the power strip, verify that the green RUN LED on the strip is on and the red LED is off.

If the red LED is on, use a multimeter to check the polarity of the wires in the power socket for wrong connections. If the zero wire (left) and the live wire (right) are correctly connected, check for missing grounding connection.

CAUTION:

Make sure the PE terminal of the power socket has been securely grounded.

Figure 59 Power strip with lightning protection



(1) Working LED (green)	If the LED is on, the circuit is working normally. If it is off, the circuit is damaged.
(2) Grounding/pole detection LED (red)	If the LED is on, the wire is not grounded or the live line and null line are reversed. Check the power supply line.
(3) Power switch	
(4) IEC standard socket	Connects the power cable to the power supply in the equipment room

(5) Overload automatic protector	The protector automatically opens the electric circuit when the current exceeds the threshold and closes the electric circuit when the current drops below the threshold.
(6) Multifunctional socket	Connects the power module of the router.

Installing a lightning protector for a network port

HP recommends that you install lightning protector for 10/100/1000 Mbps RJ-45 copper Ethernet ports. The router does not come with lightning protectors.

If part of the network cable of a 10/100/1000 Mbps RJ-45 copper Ethernet port must be routed outdoors, connect a lightning protector to the cable before you plug the cable into the port.

The following tools are required:

- Phillips or flat-blade screwdriver
- Multimeter
- Tilted wire cutter

To install a lightning protector:

1. Read the instructions for the lightning protector carefully before you install it.
2. Tear off the protection paper on one side of the double-faced adhesive tape, and stick the tape on the surface of the protector. Tear off the protection paper at another side, and stick the protector onto the chassis of the router. Keep the protector as close to the grounding screw of the router as possible.
3. Measure the distance between the protector and the grounding screw of the router, cut the ground wire of the protector and securely tighten the ground wire to the grounding screw.
4. Use the multimeter to determine if the ground wire of the protector has good contact with the grounding screw of chassis.
5. Insert the outdoor network cable into the protector's IN end, and the cable connected to the router into the protector's OUT end and look at the indicators on the lightning protector to verify the connection is correct.
6. Use nylon ties to bundle the cables.

Protector performance may be affected for the following reasons:

- The protector is installed incorrectly. Connect the IN end to the outdoor network cable and the OUT end to the network port on the router.
- The protector is not well grounded. Use the multimeter to verify that the ground wire for the protector is as short as possible to ensure good contact with the grounding screw of the router.
- The installed protectors are not sufficient. If the router has more than one network port has outdoor cabling, install one protector for each network port.

Engineering labels

Engineering labels are used to identify cables and devices for easy maintenance after installation.

There are two types of engineering labels, labels for cables and labels for devices.

Labels for cables

Cables include signal cables such as network cables and fibers, and power cables such as AC power cables and DC power cables. Labels for cables fall into labels for signal cables, labels for power cables, and generic labels.

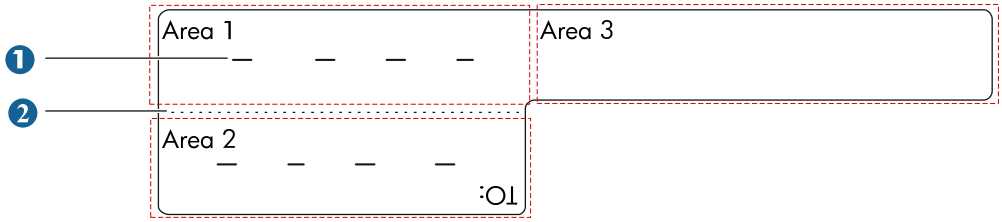
Labels for signal cables

A label for signal cables is L-shaped with fixed dimensions. The light-blue dividing lines on the label help to specify more clearly the position of the cable. For example, there is one dividing line between the rack number and the chassis number and another one between the chassis number and the slot number. The cut dotted line helps to fold the label when you affix it to the cable. A mark "TO:" is located at the lower right corner of the label to identify the peer end of the cable on which the label is affixed.

As shown in Figure 60, write a signal cable label as follows:

- Write the position of the cable in Area 1.
- Write the position of the cable on the peer end in Area 2.
- Area 3 is the part that is folded up inside the label when the label is affixed to the cable.

Figure 60 Label for signal cables



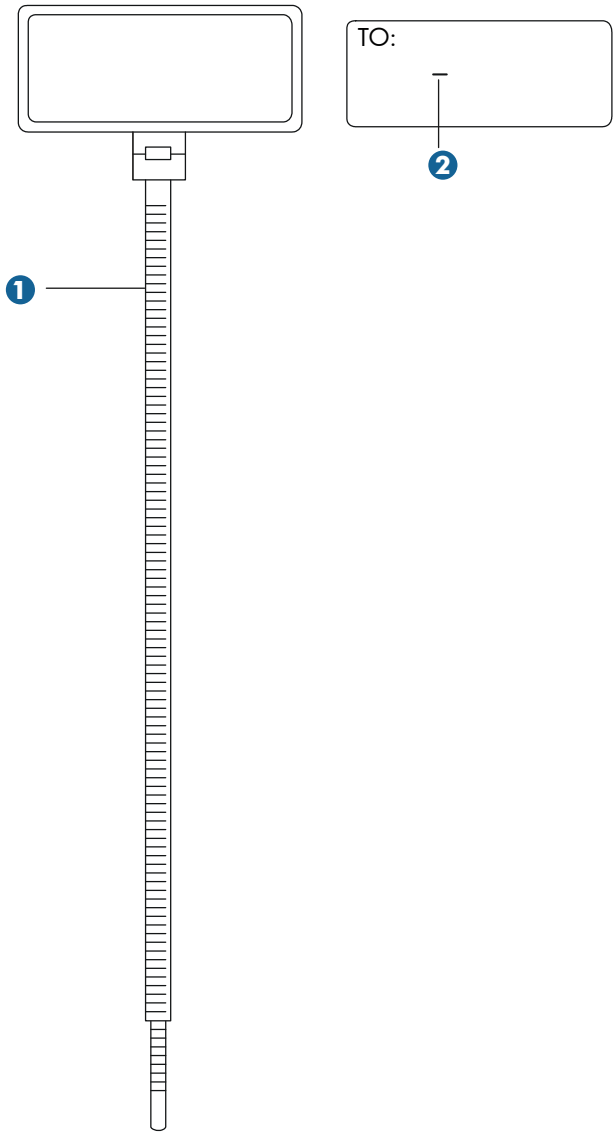
(1) Dividing line (2) Cut dotted line

Labels for power cables

A label for power cables should be attached to the identification plate on a cable tie that binds the power cables. The identification plate has an embossment of 0.2 × 0.6 mm (0.008 × 0.02 in) around (symmetric on both sides), and the area in the middle is for affixing the label.

A mark "TO:" is located at the upper left corner of the label to identify the peer end of the cable on which the label is affixed. You can write the position of the peer device, control cabinet, distribution box, or power socket. The meaning of the dividing lines is the same as labels for signal cables.

Figure 61 Label for power cables

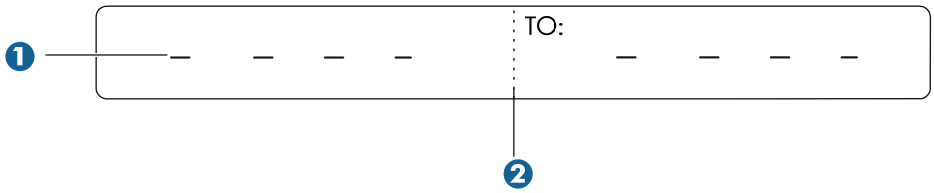


(1) Cable tie	(2) Dividing line on the label

Generic labels

A generic label is bar-shaped with fixed dimensions. It is applicable to both signal cables and power cables. A mark "TO:" is located at the upper left corner in the right area of the label to identify the peer end of the cable on which the label is affixed. The meaning of the dividing lines is the same as labels for signal cables.

Figure 62 Generic label



(1) Dividing line on the label	(2) Cut dotted line

Labels for devices

A device label is used to identify the device name, model, address, installation date, and so on.

Filling in labels

You can print or write desired contents on labels. HP recommends that you print labels.

To print labels, select a label printer and a proper label template as needed. For more information about using a label printer, see the user guide of the printer.

To write labels, use black markers. A marker has two nibs. Be sure to use the smaller nib to write labels.

Affixing labels

After printing or writing a label, remove the label from the bottom page and affix it to the signal cable, or the identification plate of the power cable.

Affixing a label to a signal cable

Typically, a label is affixed 2 cm (0.79 in) away from the connector on a signal cable. You can affix the label to other positions as needed. Figure 63 shows how to affix a label when a cable is laid vertically.

Figure 63 Affixing a label

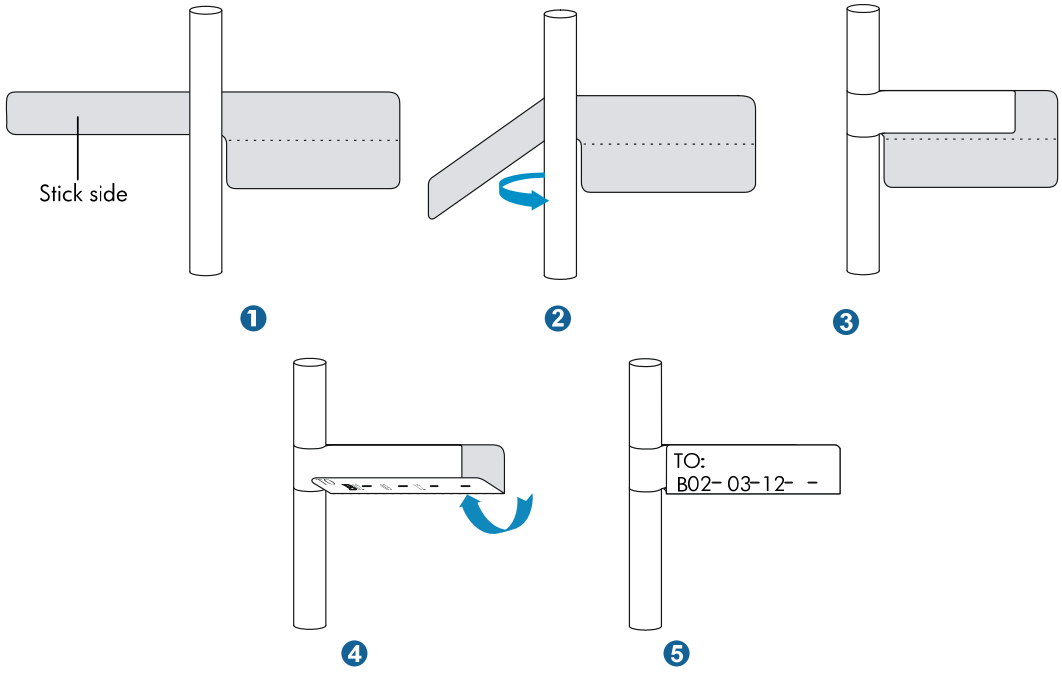
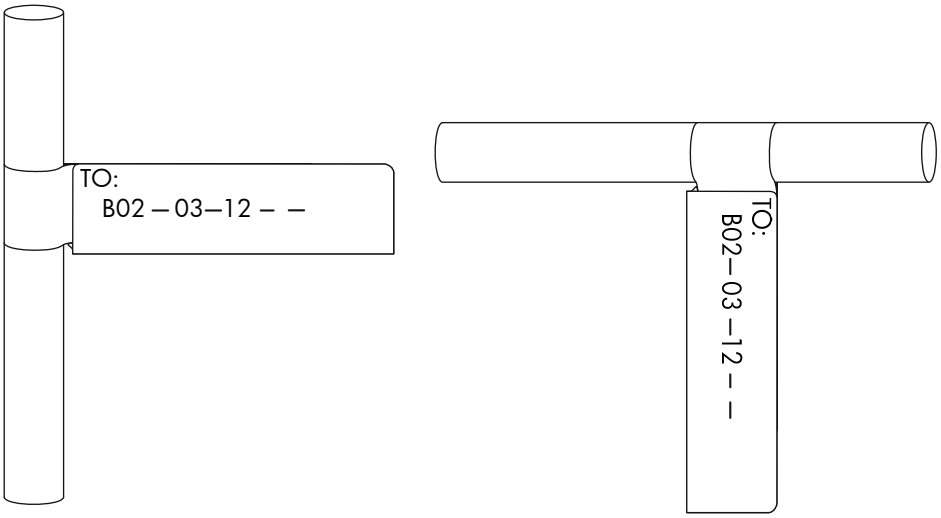


Figure 64 shows the affixed labels when the cable is laid vertically and horizontally.

Figure 64 Affixed labels

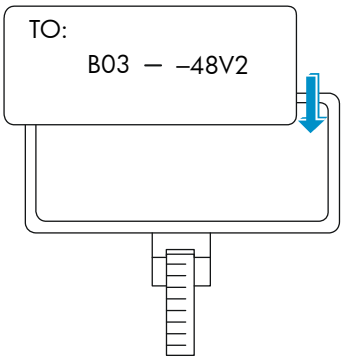


Affixing a label to a power cable

Stick the label to the recessed rectangular area on the identification plate. You can stick the label to either side of the identification plate. Be sure to affix the labels on the same side of the identification plates.

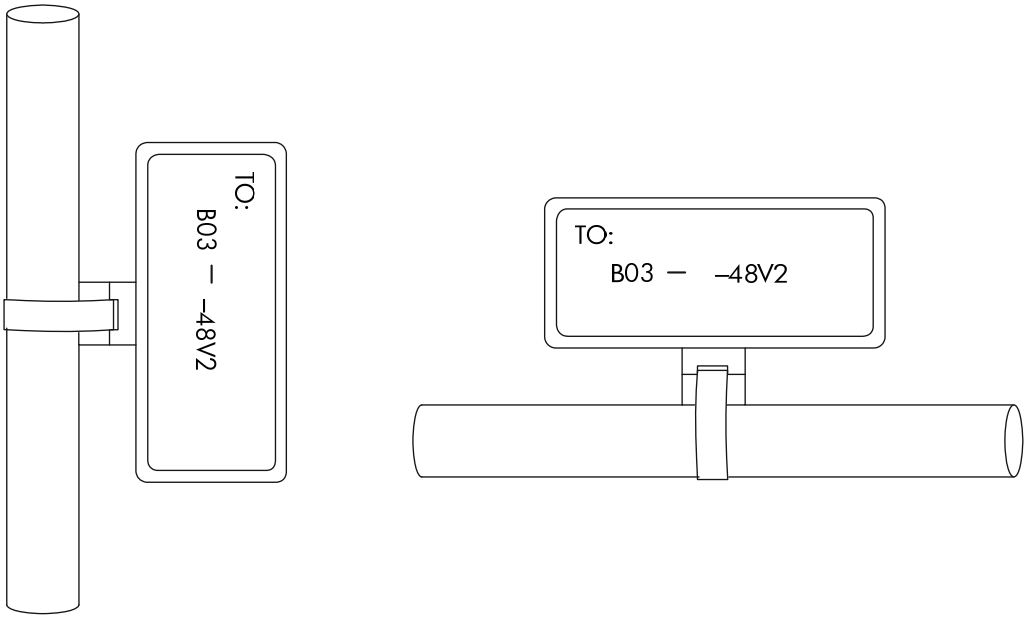
A cable tie is bundled 2 cm (0.79 in) away from the connector. You can affix the label to other positions as needed. Figure 63 shows how to affix a label when a cable is laid horizontally.

Figure 65 Affixing a label



Bind cable ties on both ends of a cable. After the bundling, the finished identification plate should be on top of the cable in horizontal cabling, or on the right side of the cable in vertical cabling. Make sure the label is facing out, as shown in Figure 66.

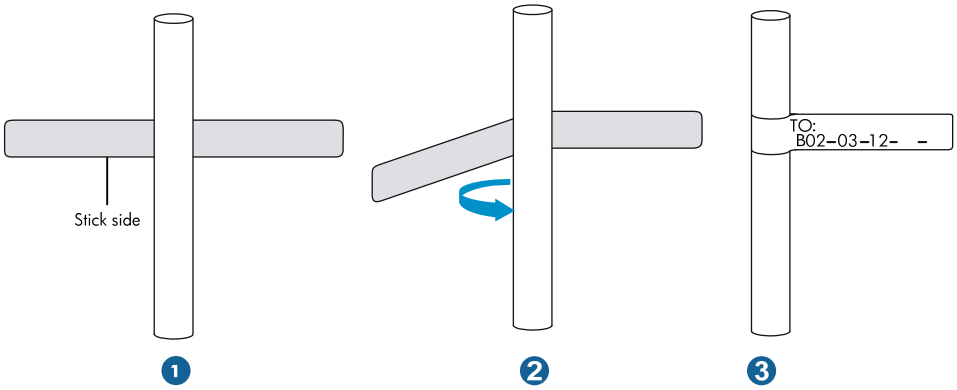
Figure 66 Affixed labels



Affixing a generic label

The requirements for affixing a generic label are the same as affixing a label on a signal cable. For more information, see "Affixing a label to a signal cable." For the example of affixed labels, see Figure 64.

Figure 67 Affixing a generic label



Affixing a label to a device

Remove the device label and stick it to the device. You can stick a device label to any desired position on the device.

Guidelines

- When you print, write, or affix labels, keep the labels clean.
- Do not use ink-jet printers and ink pens.
- Affix labels with good order in alignment.
- Avoid cable bents or other positions that might affect cable installation when you stick a label or bundle a cable tie with a power cable identification plate.
- Bundle cable ties at the same positions of power cables, with identification plates on the same side.
- The positions of "up", "down", "right" or "left" are all based on the viewpoint of the engineering person who is working on the label.

Examples

The label examples in this document are for reference only.

Engineering labels for network cables

These labels are affixed to Ethernet cables that connect cards in a chassis.

Table 55 Information on a label affixed to an Ethernet cable

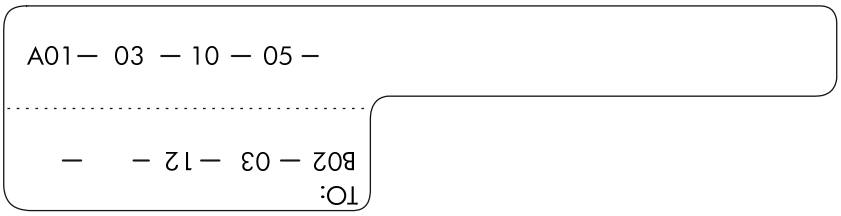
Content	Meaning	Example
MN-B-C-D	**MN**—Rack number	• **M**—Row number of the rack in the equipment room, in the range of A to Z. • **N**—Column number of the rack in the equipment room, in the range of 01 to 99. For example, A01.

Content	Meaning	Example
MN-Z	**B**—Chassis number	Numbered in top-down order with two digits, for example, 01.
	C—Slot number	Numbered in top-down and left-right order with two digits, for example, 01.
	D—Ethernet port number	Numbered in top-down and left-right order with two digits, for example, 01.
	MN—Rack number	• **M**—Row number of the rack in the equipment room, in the range of A to Z. • **N**—Column number of the rack in the equipment room, in the range of 01 to 99. For example, B02.
	Z—Location number	Location number of the terminal or device onsite. If you connect the cable to a router in a rack, specify the rack number, chassis number, and Ethernet port number, for example, B02-03-12. If you connect the cable to a terminal or an NMS, specify the location number of the terminal or the NMS.

The information provided on the following labels is different, subject to different devices that the Ethernet cables are connecting. For example:

- On a label for the Ethernet cable that connects a router and a server:
  - **For the router end**—Rack number, chassis number, and Ethernet port number on the router.
  - **For the server end**—Rack number and chassis number, or the specific location of the server if the server is laid separately.
- On a label for the Ethernet cable that connects the router and a terminal:
  - **For the router end**—Rack number, chassis number, and Ethernet port number, or the specific location of the router if the router is laid separately. The definitions of the rack number and chassis number are the same as those described in Table 55.
  - **For the terminal end**—Ethernet port number of the terminal.

Figure 68 Example of a label on an Ethernet cable



- **A01-03-10-05**—The local end of the Ethernet cable is connected to Ethernet Port 05, Slot 10, Chassis 03 of the rack on Row A, Column 01 in the equipment room.
- **B02-03-12**—The peer end of the Ethernet cable is connected to Ethernet Port 12, Chassis 03 of the rack on Row B, Column 02 in the equipment room.

Engineering labels for optical fibers

These labels are affixed to optical fibers that connect the fiber ports on the cards in a chassis, or connect fiber ports on box-type devices. There are two types of labels for optical fibers: labels for a fiber that connects the fiber ports on two devices, labels for a fiber that connects the device and the optical distribution frame (ODF).

- Labels for the fiber that connects two devices

Table 56 Information on labels affixed to the fiber between two devices

Content	Meaning	Example
MN-B-C-D-R/T	**MN**—Rack number	• **M**—Row number of the rack in the equipment room, in the range of A to Z. • **N**—Column number of the rack in the equipment room, in the range of 01 to 99. For example, A01.
	B—Chassis number	Numbered in top-down order with two digits, for example, 01
	C—Slot number	Numbered in top-down and left-right order with two digits, for example, 01.
	D—Fiber port number	Numbered in top-down and left-right order with two digits, for example, 05.
	R—Optical receiving interface **T**—Optical transmitting interface	N/A
MN-B-C-D-R/T	**MN**—Rack number	The meanings are the same as above. If the local device and the peer device are not in the same equipment room, MN can be the name of the equipment room.
	B—Chassis number	
	C—Slot number	
	D—Fiber port number	
	R—Optical receiving interface **T**—Optical transmitting interface	N/A

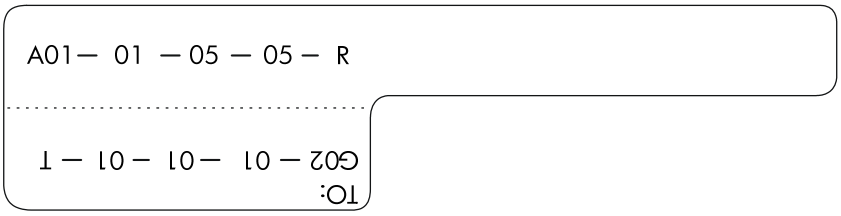
- Labels for the fiber that connects the device and the ODF

Table 57 Information on labels affixed to the fiber between the device and the ODF

Content	Meaning	Example
MN-B-C-D-R/T	**MN**—Rack number	• **M**—Row number of the rack in the equipment room, in the range of A to Z. • **N**—Column number of the rack in the equipment room, in the range of 01 to 99. For example, A01.

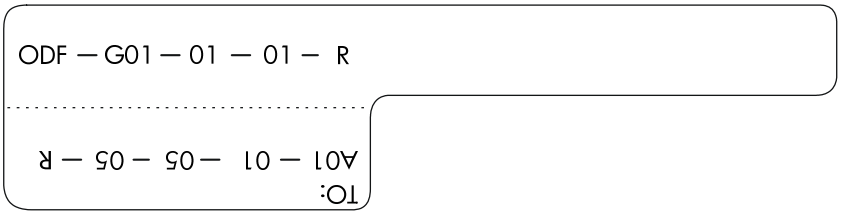
Content	Meaning	Example
ODF-MN-B-C-R/T	**B**—Chassis number	Numbered in bottom-up order with two digits, for example, 01.
	C—Slot number	Numbered in top-down and left-right order with two digits, for example, 01.
	D—Fiber port number	Numbered in top-down and left-right order with two digits, for example, 05.
	R—Optical receiving interface **T**—Optical transmitting interface	N/A
	MN—Row number and column number of ODF	• **M**—Row number of the rack in the equipment room, in the range of A to Z. • **N**—Column number of the rack in the equipment room, in the range of 01 to 99. For example, G01 is the ODF of Row G and Column 01.
	B—Row number of the terminal device	In the range of 01 to 99, for example, 01-01.
	C—Column number of the terminal device	
	R—Optical receiving interface **T**—Optical transmitting interface	N/A

Figure 69 Example of a label on an optical fiber between two devices



- **A01-01-05-05-R**—The local end of the optical fiber is connected to Optical Receiving Interface 05 on Slot 5, Chassis 01 in the rack on Row A, Column 01 in the equipment room.
- **G01-01-01-01-T**—The peer end of the optical fiber is connected to Optical Transmitting Interface 01 on Slot 01, Chassis 01 in the rack on Row G, Column 01 in the equipment room

Figure 70 Example of a label on an optical fiber between the device and the ODF



- **ODF-G01-01-01-R**—The local end of the optical fiber is connected to the optical receiving terminal on Row 01, Column 01 of the ODF in Row G Column 01 in the equipment room.

- **A01-01-05-05-R**—The peer end of the optical fiber is connected to Optical Receiving Interface 5 on Slot 05, Chassis 01 in the cabinet on Row A, Column 01 in the equipment room.

Engineering labels for DC power cables

These labels are affixed to DC cables that provide power for racks, and the protection grounding cables including the –48V, PGND, and BGND cables. The labels for DC power cables are affixed to one side of the identification plates on cable ties.

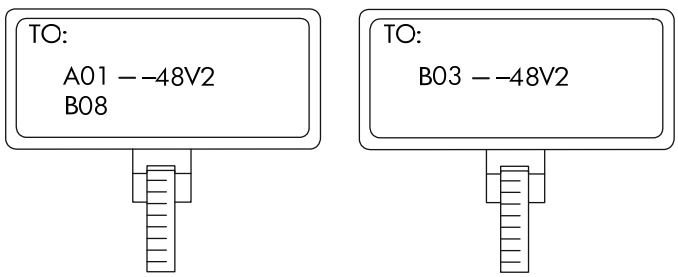
Table 58 Information on labels affixed to DC power cables

Content	Meaning
MN(BC)—48Vn MN(BC)-RTN MN(BC)-PGND	• **Loaded cabinet side**—Only MN is used to identify the cabinet number (row number and column number in the equipment room). • **Power cabinet side**—MN identifies the row and column number of the power distribution equipment like the control cabinet and distribution box. BC identifies the row and column number of the –48V connector (if there is no row number or column number, or the connector can be identified without them, BC can be omitted). RTN and PGND have no row and column number for identification. • **n**—Power port number in down-top and left-right order, in the range of 1 to 3.

The label only carries location information about the peer equipment, control cabinet, or distribution box, while the information of the local end is not necessary. Table 58 lists the information of two –48V power supplies on the label. The information for other DC voltages (such as 24V, 60V) should be given in similar methods.

Make sure labels are affixed in the correct direction. After the cable ties are bundled onto the cable, the identification plates with the labels should face up, and the text on the labels in the same cabinet should be in the same direction, as shown in Figure 71.

Figure 71 Example of labels on a DC power cable



- **A01/B08—48V2 (loaded cabinet side)**—The cable is –48V2 DC supply, which is from the 8th connecter on the second row of –48V bus bar in the cabinet on Row A, and Column 1 in the equipment room.
- **B03—48V2 (distribution box side)**—The cable is –48V2 DC supply, which is from the loaded cabinet on Row B, Column 03 in the equipment room.

In the power distribution box (or the first power cabinet of a row in the transmission equipment room), every terminal block on the –48V connector bar has a numeric identification. For example, in the above label of "A01/B08--48V2", "08" (or sometimes "8") is the numeric identification of the terminal block.

PGND and RTN are two copper bars, on which the terminal blocks are short-circuited, so which terminal is connected makes no difference. You only need to give the row and column numbers of the power distribution box, instead of giving the specific serial number of the terminal block on the copper bar. For example, if the label on the loaded cabinet side is "A01-RTN", it means that the power cable is an RTN that connects RTN copper bar in the power distribution box on Row A, Column 01 in the equipment room. Information on the labels for PGND cables should be given in the similar way.

Engineering labels for AC power cables

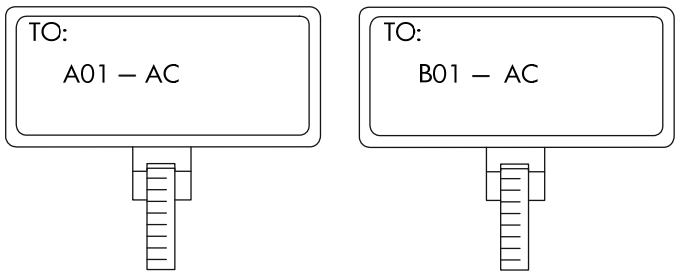
These labels are affixed to the AC cables that provide power for cabinets and protection grounding cables, including POWER, RTN, and PGND cables. The 220 VAC cables and related PGND and RTN cables are covered with insulating sheath, so the labels only need to contain "AC" and the cabinet number. The labels for AC power cables are affixed to one side of the identification plates on cable ties.

Table 59 Information on labels affixed to AC power cables

Content	Meaning
MN-AC	MN: Rack number (row number and column number in the equipment room) or the location of the socket where the power is led in. The location of the socket is marked according to onsite situation. If the sockets can be identified by row number and column number, they can be numbered following the same rule for the rack number. Otherwise, specify the detailed locations to avoid confusing with other sockets.

The label only carries location information about the peer equipment and the power socket, while information of the local end is not necessary. Make sure labels are affixed in the correct direction. That is, after the cable ties are bundled onto the cable, the identification plates with the labels should face up, and the text on the labels in the same cabinet must be in the same direction, as shown in Figure 72.

Figure 72 Example of labels on an AC power cable



- **A01-AC (loaded cabinet side)**—The power cable is connected to the socket of Row A and Column 01 in the equipment room.
- **B01-AC (power socket side)**—The power cable is connected to the loaded cabinet of Row B, Column 01 in the equipment room.

Engineering labels for devices

These labels can be affixed to any device.

You can fill in the device name, model, IP address, serial number, installation address, and installation date on a device label.

Figure 73 Example of a device label

Cable management

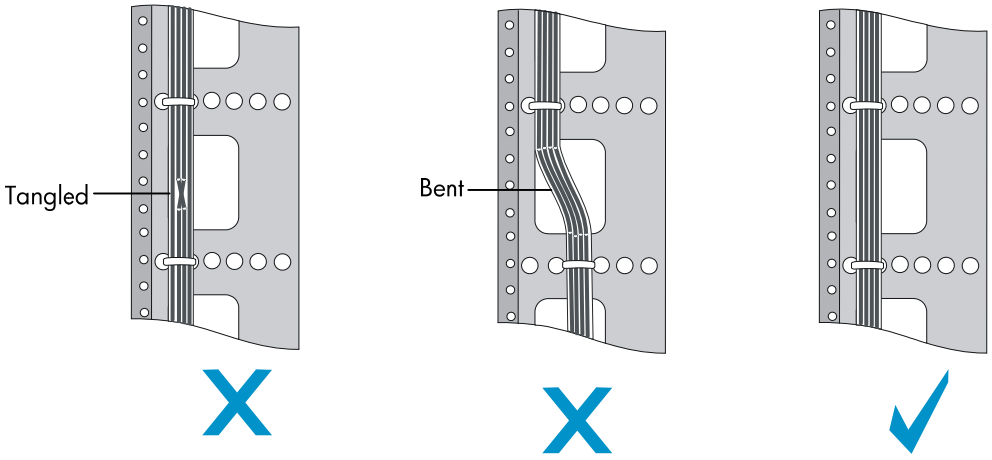
Label cables before you route or bundle them. For more information about labeling cables, see " Engineering labels for cables."

Cable management guidelines

When you route and bundle up cables, follow these guidelines:

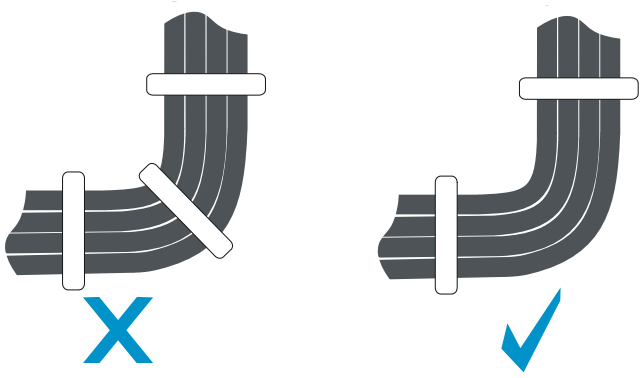
- Bind cables neatly for easy maintenance and expansion.
- The cable management brackets and cable routing slots, inside or outside the rack, are smooth and have no sharp edges or tips.
- Route different types of cables (for example, power cables and signal cables) separately. If they are close to one another, cross them over one another. If you route them in parallel, make sure the space between a power cable bundle and a signal cable bundle is at least 30 mm (1.18 in).
- Use the correct ties to bind the cables. Do not bind cables with joined ties.
- The distances between cable ties must be three to four times the cable diameter.
- Bind and route the cables neatly inside the rack, and make sure the cables are not kinked or bent. Do not tie cables or bundles in a knot.

Figure 74 Correct and incorrect cable binding



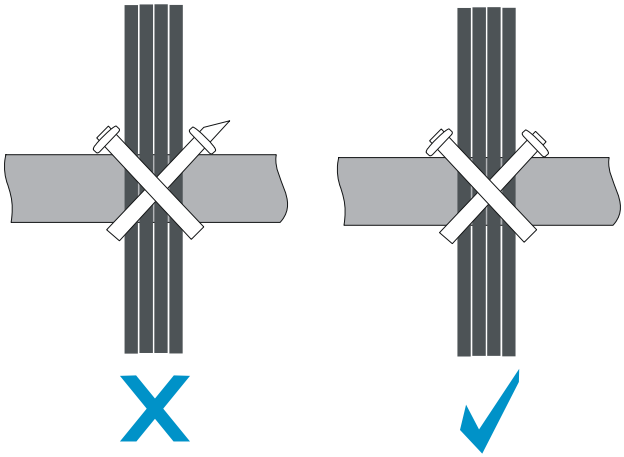
- When you bend cables, bind cables as shown in Figure 75. To avoid cable core break due to excessive stress, do not tie up the cables in the bending area. The cable bend radius at connectors must be at least 5 times the cable diameter, and must be at least twice the cable diameter away from the connectors.

Figure 75 Binding the cables



- When you route cables through sharp sheet metal penetration points or along sharp edges of mechanical parts, use bushings or take any other action to protect the cables from being cut or abraded. The sheet metal penetration points must be smooth and fully rounded.
- When optical fibers are inserted into a protective tube, wrap tapes around the edges of the protective tube to protect optical fibers from being cut.
- After binding the cables, cut the excess from the ties, leaving no sharp or angular tips.
  See Figure 76.

Figure 76 Cutting the cable ties



- Route, bind, and attach excess cables for easy, safe maintenance activities and proper operations.
- Do not tie the power cables to the slide rails.
- When you connect a cable to an articulated part, for example, when you connect a grounding cable to a rack door, leave enough slack in cables and make sure they are not stressed from any movement of the part.
- Cables must be protected at points where they might rub or come in contact with sharp edges or heated areas. Use high temperature cables near heat sources.
- Fasten heavy or rigid power cables at the connectors to relief stress.

Cable management examples

NOTE:

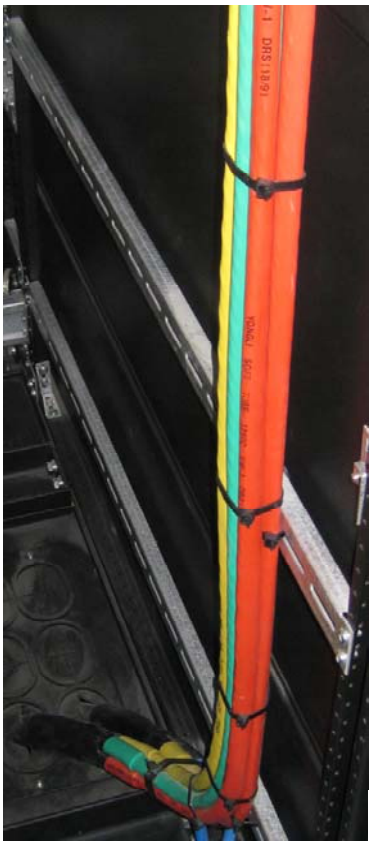
The devices in the following figures are for illustration only.

Figure 77 Network cable management

Figure 78 Optical fiber management

Use strapping tapes to carefully bind optical fibers. Avoid excessive force. For more information, see the instructions shipped with the strapping tapes.

Figure 79 Power cable management



Support and other resources

Contacting HP

For worldwide technical support information, see the HP support website:

http://www.hp.com/support

Before contacting HP, collect the following information:

- Product model names and numbers
- Technical support registration number (if applicable)
- Product serial numbers
- Error messages
- Operating system type and revision level
- Detailed questions

Subscription service

HP recommends that you register your product at the Subscriber's Choice for Business website:

http://www.hp.com/go/wwalerts

After registering, you will receive email notification of product enhancements, new driver versions, firmware updates, and other product resources.

Related information

Documents

To find related documents, browse to the Manuals page of the HP Business Support Center website:

http://www.hp.com/support/manuals

- For related documentation, navigate to the Networking section, and select a networking category.
- For a complete list of acronyms and their definitions, see *HP FlexNetwork Technology Acronyms*.

Websites

- HP.com http://www.hp.com
- HP Networking http://www.hp.com/go/networking
- HP manuals http://www.hp.com/support/manuals
- HP download drivers and software http://www.hp.com/support/downloads
- HP software depot http://www.software.hp.com

- HP Education http://www.hp.com/learn

Conventions

This section describes the conventions used in this documentation set.

Command conventions

Convention	Description
Boldface	**Bold** text represents commands and keywords that you enter literally as shown.
Italic	*Italic* text represents arguments that you replace with actual values.
[ ]	Square brackets enclose syntax choices (keywords or arguments) that are optional.
{ x | y | ... }	Braces enclose a set of required syntax choices separated by vertical bars, from which you select one.
[x | y | ...]	Square brackets enclose a set of optional syntax choices separated by vertical bars, from which you select one or none.
{ x | y | ... } *	Asterisk-marked braces enclose a set of required syntax choices separated by vertical bars, from which you select at least one.
[x | y | ...] *	Asterisk-marked square brackets enclose optional syntax choices separated by vertical bars, from which you select one choice, multiple choices, or none.
&<1-n>	The argument or keyword and argument combination before the ampersand (&) sign can be entered 1 to n times.
#	A line that starts with a pound (#) sign is comments.

GUI conventions

Convention	Description
Boldface	Window names, button names, field names, and menu items are in bold text. For example, the **New User** window appears; click **OK**.
>	Multi-level menus are separated by angle brackets. For example, **File** > **Create** > **Folder**.

Symbols

Convention	Description
WARNING	An alert that calls attention to important information that if not understood or followed can result in personal injury.
CAUTION	An alert that calls attention to important information that if not understood or followed can result in data loss, data corruption, or damage to hardware or software.
IMPORTANT	An alert that calls attention to essential information.
NOTE	An alert that contains additional or supplementary information.
TIP	An alert that provides helpful information.

Network topology icons

	Represents a generic network device, such as a router, switch, or firewall.
	Represents a routing-capable device, such as a router or Layer 3 switch.
	Represents a generic switch, such as a Layer 2 or Layer 3 switch, or a router that supports Layer 2 forwarding and other Layer 2 features.

Port numbering in examples

The port numbers in this document are for illustration only and might be unavailable on your device.

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